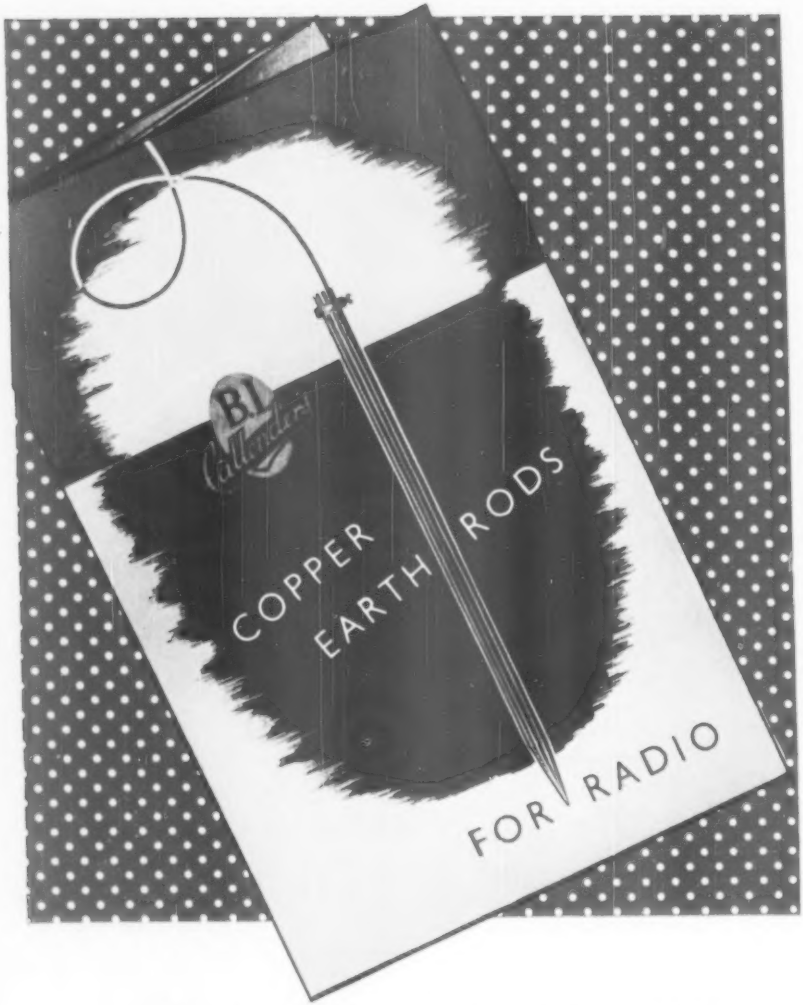
# Wireless World

RADIO AND ELECTRONICS

Vol LVI No 2 Two Shillings February 1950




Made from solid-drawn high-conductivity copper, BICC earthing rods are specially designed for use with radio and television receivers. Further information, including sizes and construction, is contained in this Publication (No. 243T). Send for a copy to-day.

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## 'AVO' *Test Instruments*

A Signal Generator of wide range and accuracy of performance, designed for use in the laboratory or by the service engineer. Turret coil switching provides six frequency bands covering 50 Kc/s to 80 Mc/s.

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| 50 Kc/s—150 Kc/s | 1.5 Mc/s—5.5 Mc/s |
| 150 Kc/s—500 Kc/s | 5.5 Mc/s—20 Mc/s |
| 500 Kc/s—1.5 Mc/s | 20 Mc/s—80 Mc/s |

### *Note these Attractive Features:*

Stray field less than 1$\mu$V per metre at a distance of 1 metre from instrument. General level of harmonic content of order of 1 per cent.

Direct calibration upon fundamental frequencies throughout range, accuracy being better than 1 per cent. of scale reading.

45in. of directly calibrated frequency scales with unique illuminated band selection giving particularly good discrimination when tuning television "staggered" circuits.

Of pleasing external appearance with robust internal mechanical construction using cast aluminium screening, careful attention having been devoted to layout of components with subsidiary screening to reduce the minimum signal negligible level even at 80 Mc/s.

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Force output 0.5 volts.

Internal modulation at 400 c/s., modulation depth 30 per cent., with variable L.F. signal available for external use.

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*Battery Model available having same general specification and covering 50 Kc/s—70 Mc/s., powered by easily obtainable batteries.*

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Mains Mode
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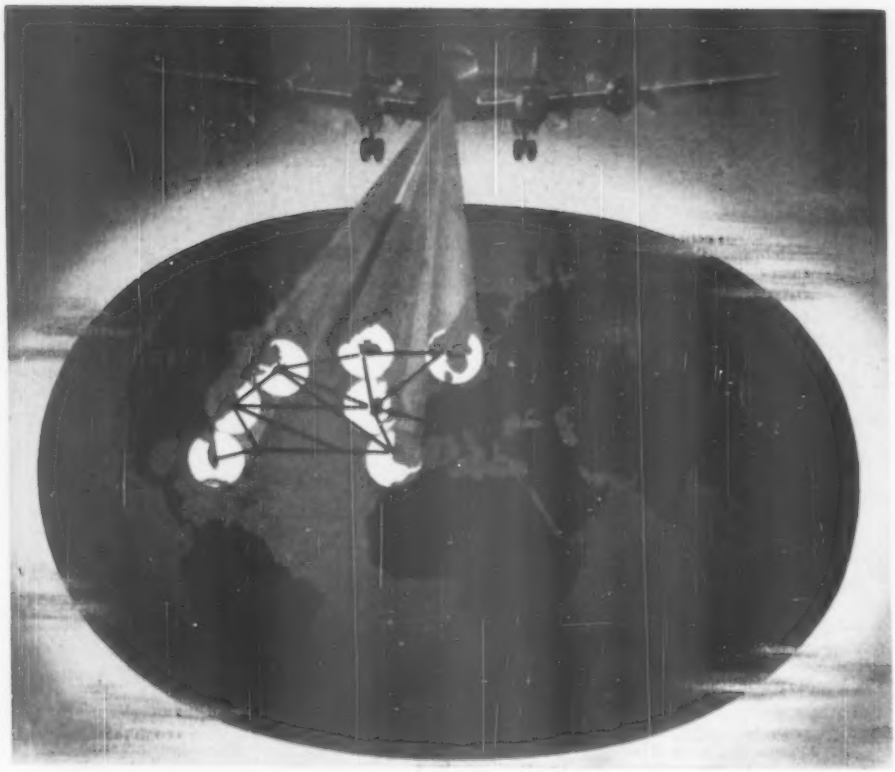

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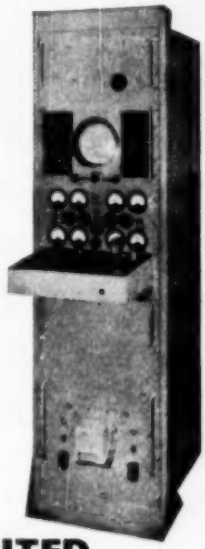
## SQUARE WAVE GENERATOR

This instrument provides a square wave of amplitudes from 5mV to 50v peak to peak calibrated, at a repetition frequency of from 5c/s to 150Kc/s. The mark/space ratio is 1 : 1 and the wave is flat to within less than ±1%, top and bottom. Alternative positive and negative pulses of 0.05, 0.1, 0.2, or 0.3 μSecs can also be obtained with amplitudes of from 5mV to 5v peak to peak.

## UNIVERSAL VALVE TESTER

This instrument will display on a cathode ray tube the Anode volt/Anode current curves for any receiving type valve. Curves for eleven different grid voltages are shown simultaneously and a calibration pattern is displayed enabling the voltage and current characteristics to be checked.



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# PREMIER RADIO COMPANY

MORRIS & CO. (RADIO) LTD.

**PREMIER MIDGET RADIO KIT.** Due to greatly increased production we are now able to offer this Kit at a greatly reduced price. Including an attractive Bakelite case, 12in. long × 5in. wide × 6in. high. The valve line up is 6K7, 6J7, 6V6 and a Selenium Rectifier in the A.C./D.C. model. Both are for use on 200 to 250 volt mains. The dial is illuminated, and the receiver presents a very attractive appearance. Coverage is for the medium and long wavebands.

Complete kit of parts with brown or ivory cabinet and diagrams, £4/19/6, inc. Purchase Tax.

**PREMIER MIDGET SUPERHET KIT.** This powerful Midget Superhet Receiver is designed to cover the short-wave bands between 16 and 50 metres and the medium wavebands between 200 and 557 metres. Two models are produced, one for 200-250 volt A.C. mains, and the other for 200-250 volts A.C. or D.C. mains. Both are supplied with the same plastic cabinet as the TRF Receiver. The A.C. valve line-up is 6K8, 6K7, 6Q7, 6V6 and a selenium rectifier. The A.C./D.C. line-up is the same, with the exception of the output valve which is a 25A6. The dial is illuminated, making a very attractive receiver.

Complete kit of parts with brown or ivory cabinet and diagrams £6/13/6, inc. Purchase Tax.

**PLASTIC CABINETS.** as illustrated above. In Brown or Ivory 17/6.

**COLLARO AUTOMATIC RECORD CHANGERS.** Type RC500 Auto-drive. Plays nine 10in. or 12in. records. A.C. 100/250 v., with High Fidelity Magnetic or Crystal Pick-up. £10/15/-. With Sapphire stylus, £12/3/4.

**COLLARO GRAMOPHONE UNITS.** High grade Rim-drive Motors, complete with Pick-up and Automatic Stop-Start. A.C. 100/250. With Magnetic Pick-up, £5/3/3. With Crystal Pick-up, £5/17/7.

**COLLARO GRAMOPHONE UNITS AT NEARLY HALF PRICE.** Motor, Tone arm and Pick-up in one unit. Auto Stop-Start, variable speed, 12in. turntable. Induction Motor for 100/250 v., 50 cycles, with Magnetic Pick-up, £6/6/-. With Crystal Pick-up, £7/4/9.

**CONRAD GRAMOPHONE MOTORS.** A reliable Rim-drive Motor for A.C. 100/250 v. operation, £3/17/6.

**GOVERNMENT SURPLUS MAINS TRANSFORMERS.** All are for use on 230 volt 50 cycle Mains.

| Type | | Price |
|---|---|---|
| 42 | 500-0-500 v. 170 mA. 4 v. 4 a. | 25/- |
| 44 | 10 v. 5 a., 10 v. 5 a., 10 v. 5 a. | 35/- |
| 53 | 350-0-350 v. 80 mA., 5 v. 3 a., 6.3 v. 2.3 a. | 15/- |
| 54 | 275-0-275 v. 60 mA., 5 v. 2 a., 6.3 v. 3.5 a. | 15/- |
| 55 | 250-0-250 v. 100 mA., 5 v. 2 a., 6.3 v. 3.5 a. | 17/6 |

**WILLIAMSON AMPLIFIER KIT.** We can supply the Kit of Parts for the latest version of this famous amplifier complete in every detail for £10/10/-.

**WILLIAMSON AMPLIFIER OUTPUT TRANSFORMERS** to specification, £3/-.

Mains Transformers, 45/-.

**H.T. ELIMINATOR AND TRICKLE CHARGER KIT.** All parts to construct an eliminator to give an output of 120 volts at 30 mA. and 2 volts to charge an accumulator. Uses metal rectifier. 35/-.

**TELEVISION AERIALS.** The K.A. Loft Aerial for those close to the transmitter. London or Birmingham frequency, 20/-.

**WALL FIXING DIPOLE,** 32/6.

**WALL FIXING DIPOLE** with reflector, 60/-.

See our new catalogue for complete range.

**V.C.R.97.** C.R. Tubes. New and tested to give full size picture, 37/- each.

The following C.R. Tubes for callers only —

| | | | |
|---|---|---|---|
| VCR516A | 40/- | VCR517 | 15/- |
| VCR517E | 30/- | VCR517B | 60/- |
| VCR140 | 50/- | | |

**TRANSMITTING AND SPECIAL PURPOSE VALVES.**

| | | | |
|---|---|---|---|
| 805A | 10/- | ELIS (CV1137) | 5/- |
| 801 | £10 | 806 | 25/- |
| 802 | 10/- | HY114B (CV1036) | 15/- |
| V403 (CV1066) | 6/6 | MX200 (CV1303) | 15/- |
| EL38 (CV12) | 40/- | 1616 | 5/- |
| 803 | 17/6 | 8012 | 10/- |
| KR/8 (CV160) | 60/- | 843 | 5/- |
| EL91 (CV12) | 60/- | 1625 | 5/- |
| EHTT (CV18) | 60/- | U19 (CV167) | 6/6 |
| V700 (CV1060) | 7/6 | 956 (CV449) | 3/6 |
| U17 (CV1118) | 5/- | X99 (CV1190) | 5/- |
| EF39 (CV769) | 20/- | CV8C (Klystron) | 5/- |
| PT25B (CV1048) | 5/- | 6U30 (CV1070) | 7/6 |
| VU133A (CV34) | 6/6 | 1626 (CV1138) | 3/6 |

**ELECTRON MULTIPLIER PHOTO CELL TUBES.** Type 931A. Brand new. Guaranteed, 30/-.

**T.V. WHITE RUBBER MASKS.** We can now supply a specially designed White Rubber Mask for 6in. C.R. Tubes at 7/6 each.

9in. White Masks, 8/6. 12in. White Masks, 15/9.

**SUPER QUALITY TELEVISION MAGNIFYING LENS.** to suit 5in., 6in. or 7in. Tubes. Increase picture size considerably. 25/- each.

**FRAME AND LINE COIL ASSEMBLY.** Suitable for all standard Magnetic Tubes, 12/6 each.

**PERMANENT MAGNET FOCUS POTS.** Available for all Tubes, 15/-. Please state Tube used.

**THE NEW PREMIER 1950 CATALOGUE**

contains all the newest TV Kits, Components, Aerials, Tubes, etc., in addition to thousands of Radio Bargains.

**Now ready — 3d.**

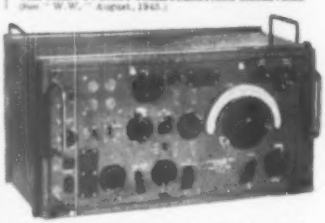
**SUPER MOVING COIL MIKE AND STAND.** We have purchased the entire stock of a famous Manufacturer of PA Equipment at a very low price, and are offering a £5/5/- Super Moving Coil Mike, with a chromium plated folding stand to match. The list price of the stand was £1/5/-.

**WE OFFER THE PAIR AT 79/6. LESS THAN HALF THE USUAL PRICE.**

THE NEW PREMIER TABLEGRAM

A modern Tablegram, incorporating many new features. Covers Medium and Long Wavebands. Operates on 200/250 v. A.C. Mains. A high-fidelity pick-up and the latest Goldring dynamic process motor ensure excellent record reproduction. £19/19/-, including Purchase Tax.

**A LARGE NEW PURCHASE ENABLES US TO OFFER AT A LOWER PRICE THAN EVER BEFORE, ONE OF THE ARMY'S FINEST COMMUNICATIONS RECEIVERS.**
(See "W.W." August, 1949.)



9 valves, R.F. amp. (as Frequency Changer), 2 I.F.s (465 kc.), 2nd Detector, A.V.C. Af. amp. B.F.O. A.C. mains, 100/250 v. or 12 v. accum. Frequency range 12.5 to 7 Mcs. 7.50 Mcs to 2.9 Mcs. 2.0 to 1.2 Mcs. Monitor L.S. built in. Complete. Write for full details. Price £19/12/-, plus 21/- carriage and packing.

**BATTERY CHARGERS.**
Input 100/250 v. A.C. Output 12 volts at 16 amps. Continuously variable metered output. Usual price £34. Our price £10/10/- each, plus 10/- carriage.

**BATTERY CHARGER KITS.**
All incorporate Metal Rectifiers. Transformers are suitable for 200/250 v. A.C. 50 cycles.

| Cat. No. | | Price |
|---|---|---|
| 2002. | Charges 6-volt Accumulator at 1 amp. Resistance supplied to charge 2 v. Accumulator | £1/3/6 |
| 2003. | Charges 12-volt Accumulator 1 amp. | £1/7/6 |
| 2004. | Output 15 v. 6 a. Variable Resistance and Meter | £3/15/- |
| 2005. | Output 15 v. 6 a. Variable Resistance and Meter | £5/-/- |
| 2007. | Output 30 v. 5 a. Variable Resistance and Meter | £6/-/- |
| 2009. | Output 24 v. 3 a. Variable Resistance and Meter | £4/5/- |

**ALUMINIUM CHASSIS.** 16 S.W.G. Substantially made of bright aluminium with four sides.

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| 7 × 3½ × 2in. | 3/1 |
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| 12 × 9 × 2½in. | 6/6 |
| 14 × 9 × 2½in. | 6/11 |
| 14 × 8 × 2½in. | 7/3 |
| 16 × 8 × 2½in. | 7/11 |
| 12 × 10 × 2½in. | 10/- |
| 10 × 9 × 3in. | 6/3 |
| 12 × 10 × 3in. | 6/10 |
| 14 × 10 × 3in. | 7/11 |
| 16 × 10 × 3in. | 8/6 |
| 18 × 10 × 3in. | 10/- |

**MAINS NOISE ELIMINATOR KIT.**
Two specially designed chokes with three smoothing condensers with circuit diagram. Cuts out all mains noise. Can be assembled inside existing receiver. 6/- complete.

**CO-AXIAL CABLE.**
Super quality cable, consisting of a centre copper core, a polythene dielectric insulator, a flexible screen, a weather-proof P.V.C. outer cover. Just the thing for Television lead-in, super noise cable, etc., 80 ohms impedance. Cat. No. C126, 3d. per foot.

**GRAMOPHONE AMPLIFIER KIT.**
Consists of Complete Kit of Parts for a 2½ watt, Mains-operated 2-stage Amplifier for use with any type of pick-up. Volume and tone controls are incorporated. Output impedance 3 ohms.
Cat. No. AMP147. Price complete, 65/-. For 200-250 v. mains with valves and diagrams.

**SECTIONAL WHIP AERIAL.** Seven sections which plug into each other making an aerial 14ft. long. Thinnest section ½in. diam. Thickest section 1½in. diam. Weather-proof round. 3/6 each complete.
**INSULATED BASE** for above, 2/6 each.

**METER KIT.**

**A FERRANTI 500 MICROAMP M.C METER,** with separate High Stability, High Accuracy, Resistors to measure, 1½, 60, 150 and 300 volts D.C. Scale length 1½in. diameter 5½in. 10/- the complete kit.

**5 KV. ELECTROSTATIC VOLTMETER.** Scale length 7½in., flush mounting, 4½in. diameter, £2/10/-.

**207, EDGWARE ROAD, W.2** Phone: AMBassador 4033

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All **POST ORDERS** to 167, LOWER CLAPTON ROAD, LONDON, E.5. 'Phone: AMHerst 4723

Terms of Business: Cash with order or C.O.D. over £1. Send 2d. stamp for list.

*EDGWARE ROAD IS OPEN UNTIL 6 p.m. ON SATURDAYS*

# PREMIER RADIO COMPANY

MORRIS & CO. (RADIO) LTD

THE BIRMINGHAM VERSION OF THE

## "PREMIER" TELEVISOR KIT

is now ready. The price is the same as the London Model

## £17 - 17 - 0

As is usual in all Premier Kits every single item down to the last Bolt and Nut is supplied. All chassis are punched and layout diagrams and theoretical circuits are included.

Five Easy to Assemble Kits are supplied :—

| | |
|---|---|
| **VISION RECEIVER** with valves, carriage 2/6 | £3 13 6 |
| **SOUND RECEIVER** with valves, carriage 2/6 | £2 14 6 |
| **TIME BASE** with valves, carriage 2/6 | £2 7 6 |
| **POWER SUPPLY UNIT** with valves, carriage 5/- | £6 3 0 |
| **TUBE ASSEMBLY**, carriage and packing 2/6 | £2 18 6 |

This unit includes the VCR97 Tube, Tube Fittings and Socket and a 6in. P.M. Moving Coil Speaker with closed field for Television. The Instruction Book costs **2/6**, but is credited if a Kit for the complete Televisor is purchased.

Any of these Kits may be purchased separately ; in fact, any single part can be supplied. A complete priced list of all parts will be found in the Instruction Book.

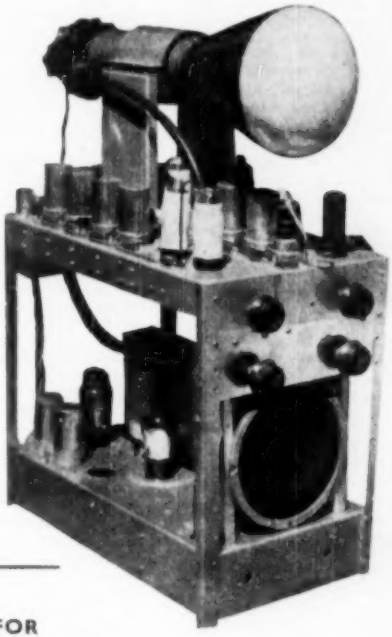
20 Valves are used, the coils are all wound and every part is tested. All you need to build a complete Television Receiver is a screw-driver, a pair of pliers, a soldering iron and the ability to read a theoretical diagram.

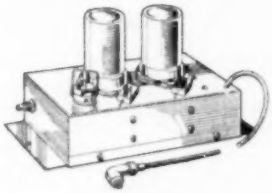
A well-made walnut finish

**PEDESTAL CABINET**

is available at **£5 10 0** *plus 7/6 carriage and packing.*

Working Models can be seen during transmitting hours at our Fleet Street and Edgware Road Branches.





### PRE-AMPLIFIER FOR FRINGE RECEPTION AREAS

We can supply the complete kit of parts to make this wide band width Pre-Amplifier, using 2 EF54 Pentodes. Powered by the TV Kit, it is completely screened. With all parts, valves, chassis, diagrams, etc., **27/6**. All parts available separately.

PLEASE STATE IF THE LONDON OR BIRMINGHAM MODEL IS REQUIRED.

AT

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Terms of Business : Cash with order or C.O.D. over £1. Send 2d. stamp for list.

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# MAINS TRANSFORMERS

**Ordinary—E.H.T.—Special.**

All transformers are suitable for 200-250 v. 50 cycle mains, are fitted with primary screens, fully impregnated and complete with all necessary clamps, etc.

260-0-260 at 80 mA. 6.3 v. at 4 amp. 5 v. at 3 amp. Half shrouded drop through, **15/-**.

260-0-260 at 60 mA. 6.3 v. at 3 amp. 5 v. at 2 amps. Half shrouded drop through. Price **13/9**.

350-0-350 at 80 mA., 4 v. at 6 amps. 4 v. at 3 amps., drop through or upright mounting, primary having an additional tapping for 110 v. mains. Obviously a useful replacement type for old type receivers. **16/6**.

350-0-350 at 100 mA., 6.3 v. at 5 amps., 5 v. at 2 amps. Fully shrouded upright mounting, **19/6**.

260-0-260 at 60 mA. 4 v. at 4 amps. 4 v. at 3 amps. Half shrouded drop through. Price **13/9**.

235-0-235 at 60 mA. 6.3 v. at 3 amp., 5 v. at 2 amps. Fully shrouded upright mounting, **15/-**. Primary has an additional tap for 110 v.

Filament Transformer, 6.3v. 1½-2 amps, upright, **6/-**.

350-0-350 at 150 mA., 5 v. at 3 amps., 6.3 v. at 6 amps., 6.3 v. at 3 amps. Fully shrouded upright mounting, **36/-**. Note this transformer and next two below are the correct specification for the "Inexpensive Televisor."

250-0-250 at 100 mA., 5 v. at 3 amps., 6.3 v. at 6 amps., **27/6**.

2,500 v. at 5 mA., 4 v. at 1.5 amp., 202 v. at 2 amp., **27/6**.

4 KV. at 5 mA., 2 v. at 2 amp., potted with insulators, **67/6**.

Special combined transformer designed to be suitable for Televisor or oscilloscope using a 6in. tube VCR97, etc.

400-0-400 at 150 mA., 2.5 KV. at 5 mA., 6.3 v. at 6 amps., 6.3 v. at 6 amp., 6.3 v. at 2 amp., 4 v. at 1 amp., 4 v. at 2 amps., 5 v. at 3 amp., **70/-**.

### IMPORTANT

Postage must be included, orders up to 10/-, 1/-, over 10/-, 1/6, £3 and over post free unless otherwise stated.

# PARTS FOR TELEVISORS

**FRAME AND LINE COIL ASSEMBLY.** Perfectly made by a very famous maker, for standard type magnetic tubes, 9in., 10in., 12in. or 15in., we have a limited number only, the price is **16/6**, and cannot be repeated once these are cleared, so please act quickly.

**P.M. FOCUSING for clear pictures**

**PERMANENT MAGNETIC FOCUSING UNITS.** No current drain—for all makes of tubes—patented method of adjusting the gap, giving really clean pictures and even focus of whole of the tube free. Price **16/6** each.

**R.F. E.H.T. Non-Lethal**

**R.F. E.H.T.** We were so pleased with the quality of this unit that we have taken up the entire output of the manufacturer, the voltage can be adjusted to make it suitable for working 9in., 12in. or 15in. tubes, the unique design and vacuum impregnation combine to give a trouble-free unit which will give years of satisfactory service, and, of course, the big point about the R.F. E.H.T. is that it is not lethal, the size is only 4½ × 3½ × 4in., price complete ready to operate, **65/-**.

**£16 FOR A MAGNETIC TELEVISOR** (and H.P. terms if you wish). This Televisor is suitable for use with 9, 10, or 12in. magnetic tube (not included in the £16). No Ex-Government units are used, you start off with all basic components, brand new and guaranteed, except for the valves which are Government Surplus though again guaranteed. This Televisor was demonstrated at Radiolympia, and we will demonstrate to you if you can call during transmitting time. All parts available separately for those already having some of them. Detailed point-to-point wiring and instructions for novice or expert, **5/-**. Explanatory leaflet free. When ordering booklet please state whether for Birmingham or London.

**£15 5/- FOR A COMPLETE TELEVISOR,** this is our famous Mark II which is doing good service all over the country. Two Ex-R.A.F. Units are used, and these save you a good deal of work. These and all the other parts including the loudspeaker needed to make the working televisor are included in the £15 5/-. Technical knowledge is necessary because you have to work from theory diagrams. 24 pages of data are included free if you buy the Kit, or alternatively will be supplied at 7/6 per copy.

**"50 PITFALLS FOR TELEVISION CONSTRUCTORS."** If you are having difficulty in getting a perfect picture, then this publication may solve your problem. The price is only 2/6 post free.

**WHITE PLASTIC MASK.** Designed to fit a 6in. electrostatic tube, VCR.97, etc. This will give a professional look to your home-built Televisor. If yours is a bigger than usual picture, the size of the opening can be enlarged to suit your own needs. The price is 7/6 post free.

**MAGNIFYING LENS.** De Luxe type. The lens which is really designed to give optical perfection. First-class quality and workmanship throughout. Guaranteed against any discoloration of the special oil content. Price **39/6**, postage, packing and insurance 5/-.

**AERIALS.** Indoor type—for fitting in loft. Very simple in installation. Full instructions and fixing clips, etc., supplied with every one. Order "SNAPPY AERIAL KIT," price **15/-**.

**VCR.97 CATHODE RAY TUBES.** Brand new in original cartons. Price **35/-**, carriage and insurance paid. Buy a spare now while they are still available at this silly price.

**PRE-AMPLIFIER FOR TELEVISION.** Complete conversion details using RF27 (ex-R.A.F. Unit). Unit with details **22/6**, nothing else needed, suitable for sound or vision. Details separately, **2/3** post free.

**CO-AXIAL CABLE.** 80 ohm thin, **10d.** per yard, 80 ohm Government surplus thick, **8d.** per yard. Twin balanced feeder, **4d.** per yard.

**E.H.T. CONDENSERS.** .1 mfd. 2.5 K.V., **2/6**. .1 mfd. 5 K.V., **4/9**. .1 mfd. 7 K.V., **13/6**. .02 mfd. 8 K.V., **3/9**.

**DECOUPLING CONDENSERS.** Very small bakelite moulded mica insulation, .001 mfd. or .0005 mfd., **6/-** per dozen.

# SPARES

### ELECTROLYTIC CONDENSERS

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|---|---|
| 8 mfd. 350 v. | **1/6** |
| 16 mfd. 350 v. | **1/11** |
| 25 × 25 mfd. 200 v. | **3/11** |
| 8 mfd. 150 v. | **1/3** |
| 25 mfd. 25 v. | **1/-** |
| 25 mfd. 50 v. | **1/6** |
| 50 mfd. 12 v. | **10d.** |
| 50 mfd. 50 v. | **1/9** |
| 10 mfd. 25 v. | **10d.** |
| 2 mfd. 450 v. | **1/-** |
| 4 mfd. 450 v. | **1/3** |
| 8 mfd. 450 v. | **1/11** |
| 16 mfd. 450 v. | **2/8** |
| 8 × 8 mfd. 450 v. | **3/4** |
| 8 × 16 mfd. 450 v. | **3/4** |
| 16 × 16 mfd. 450 v. | **3/9** |
| 16 × 8 × 24 mfd. | **4/2** |
| 8 mfd. 500 v. BR.850 | **2/6** |
| 16 mfd. 500 v. BR.1650 | **3/6** |

### P.M. SPEAKERS.

| Size | with trans. | less trans. |
|---|---|---|
| 2½in. | — | **10/6** |
| 3½in. | — | **8/6** |
| 5in. | **12/3** | **10/6** |
| 6½in. | **12/6** | **10/6** |
| 8in. | **14/6** | **12/6** |
| 10in. | **18/6** | **16/6** |
| 12in. | — | **39/6** |

### ENERGISED SPEAKERS

Size 6½in. with 700 ohm field and output transformer (Rola), **11/6**. Less trans., **9/6**.

Size 8in. 2,000 ohm with output transformer, **15/6**.

### I.F. TRANSFORMERS

465 kc/s, iron dust cored standard size can, **6/9** pair.

465 kc/s, iron dust core, midget size can, **12/6** pair.

465 kc/s, air cored small size can, **5/9** pair.

### OUTPUT TRANSFORMERS

Standard pentode matching to 3-4 ohm speech coil. Standard size, **3/3**, small size **3/-**, midget size **3/6**.

Multi-ratio, standard size **4/6**.

### TUNING CONDENSERS

Small size 2 gang .0005 with long spindle, **4/6**. Ditto, with trimmers, **6/6**. Midget size 2 gang .00035 with dust cover and trimmers, **7/6**.

4 gang .0005 with built-in trimmers, fitted into screening compartment, but easily removable, **3/9**.

### IRON CORED CHOKES.

| | |
|---|---|
| 200 mA. 10 henry | **10/-** |
| 200 mA. 5 henry | **6/-** |
| 200 mA. 3 henry | **5/-** |
| 80 mA. 10 henry | **4/6** |
| 80 mA. 5 henry | **4/-** |

### MISCELLANEOUS ITEMS

8 kv. sleeving, **3/-** doz. yds. B7G ceramic valve holder, **1/3**. Ditto, EF50, **9d.** Pax EF50, **6d.** Int. Oct. Valve holder Amphenol, **6d.** Pax, **3d.** Miniature look pots., **1/6**.

ELECTRONIC PRECISION EQUIPMENT (2) ELECTRON HOUSE, Windmill Hill, RUISLIP MANOR, MIDDX.

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For servicing all types of British and American gear. You have needed these spanners in the past and you will continually need them in future. Total of 50 precision tools :—

5 Whitworth ring spanners ¼ to ⅞.
5 American ring spanners, ¼ to ⅞.
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6 Double-ended American ¼ to ⅞.
3 Whitworth obstruction wrenches, ¼ to 7/16.
3 American obstruction wrenches, ¼ to ⅞.
6 B.A. Ignition spanners 1 to 6 B.A.
6 American Ignition spanners.
4 Small B.A. Fitters' spanners.
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This complete kit, **£5/17/6.**

### B.A. SOCKET SPANNERS.

Covering sizes 0-6 B.A. and with double ended wrench as illustrated. A really good set which will help you with those nuts in awkward corners, price **5/6** complete.

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Covering sizes 1 to 6 B.A., these are so made to have a straight and a right angle end for each B.A. size. **6/-** set.

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### PUSH-BUTTON SWITCH UNIT.

For three waveband and mains on/off complete with knobs. **1/6.**

### EGG INSULATORS.

For all sorts of aerials including T.V. 1½ long × 1 × 1. **4d.** each. **3/6** doz.

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As illustrated **7d.** each, sockets to suit, **10d.** each.

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Selenium 250 v. 100 ma., **4/3.**

### 5-WAY PORCELAIN CONNECTOR BLOCKS

Hundreds of useful applications, **1/3.**

### 33 R.P.M. GRAM MOTORS

Ex-Government but in good condition only a few left, **£3** each.

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Postage must be included orders up to 10/-, 1/-, over 10/-, 1/6, £3 and over post free unless otherwise stated.

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Radiogram unit by a very famous maker, comprising centre drive induction motor, type AC47 with speed regulator, auto-stop and magnetic pick-up all mounted on full size unitplate. Brand-new in manufacturer's cartons. Limited quantity, **£4/16/6,** plus 3/6 carriage and insurance.

# SELECTED SURPLUS (Ex-Govt.)

**10 K.V.A. ALTERNATOR SETS.** Ideal for country house or if you are setting up a workshop or laboratory in a remote place, then these are an ideal unit because in addition to the main output of 10 K.V.A. 230 v. 50 cycles 3 phase there is also 1.5 K.V.A. 230 v. 400 cycles. These alternator sets are complete with exciter, voltage regulators, switch board, frequency meters, amp. meters, and iron-clad switch fuses for output. They are mounted on stout angle-iron stand and are complete with "Vee" belt pulley, the alternator is designed to run at 1,500 r.p.m., but being belt driven they can, of course, be driven by an engine of almost any speed, as the difference can be adjusted by the size of the pulley on the engine. Unused but storage soiled. Price is **£85** each, ex works.

**TYPE 6 INDICATOR.** As specified for the "Wireless World" oscilloscope (reprint of data **9d.**). Also for the "Inexpensive Televisor" (booklet **1/6**), and the Mark I Televisor (Constructors envelope **2/6**). These indicators are brand-new, packed and sealed in manufacturer's original crates, they contain VCR.97 Cathode Ray Tube, 4 EF50 valves, 3 other valves, and hundreds of useful components, including wire-wound pots. Price is only **£4/10/-,** plus carriage and packing 7/6.

**10 VALVE 1½ METRE SUPERHET.** Ideal for conversion into a Midlands or London region Televisor. These contain 6 valves type SP61, and 1 each RL7, RL16, and EA50. 6 I.F. Transformers of 12 mc/s, 4 mc/s band width, and hundreds of other useful components. Complete with three 11 mm. formers, price **59/6,** plus carriage and packing 5/-. These receivers are unused, being in original wrappings.

**RADAR RECEIVER TYPE 3084A.** These require only the smallest of modification to make them into a sound and vision televisor. Main contents are valves: 7 EF50, 2 VR136, 1 VR137, 1 HVR2, 1 R3, 1 V507, 1 EA50, wire-wound variable resistors, small 80 v. A.C. motor, and dozens of useful components, resistors, condensers, etc. Brand-new, in original manufacturer's packing and transit case, price **59/6,** carriage 5/-.

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| TZ40 | 27/6 | CV57 | 30/- | 8011 | 18/6 |
| 5Z3 | 13/6 | 6N7 | 6/6 | 832 | 16/6 |
| GU21 (CV5) | | VS68 (STV280/40) | | PT15 (VT104) | |
| VT25 (DET25) | | VU508 (CV1508) | | | |

Many other types available including Magnetrons, Klystrons, Thyratrons, etc., etc. Send us your enquiries.

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Suitable for intercommunication between offices, workshops, stores, garages, big houses, kitchens, etc. Each station consists of normal size Bakelite handsets and desk or wall-mounting cabinet with built-in selector switch, buzzer and push. All stations can communicate with one another independently. Each installation is absolutely complete and internally wired. 3-station installation complete with 50 yards 5-core cable **£6/10/-.** 4-station installation, complete with 50 yards 6-core cable, **£8/10/-.** 2-station installation, complete with 25 yards 4-core cable, **£3/17/6.**

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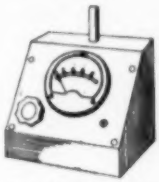

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15 amp. shuttered switch plug, bakelite moulded surface mounting type, made by very famous maker, made to B.S.S. **6/-** each.

ELECTRONIC PRECISION EQUIPMENT (2) ELECTRON HOUSE, Windmill Hill, RUISLIP MANOR, MIDDX.

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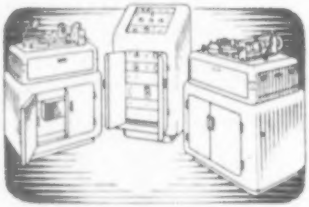
*Illustrated below is a typical M.S.S. Studio Recording equipment, but the M.S.S. range includes Portable Studio Recording equipment, Portable Recorders for the professional and also home recording equipment. Full details will gladly be sent on request.*



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***ACTUATION BY PROXIMITY of solid or liquid conductors or insulators to an electrode terminating a co-axial cable.***

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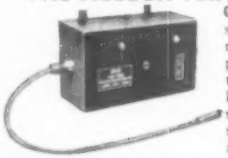

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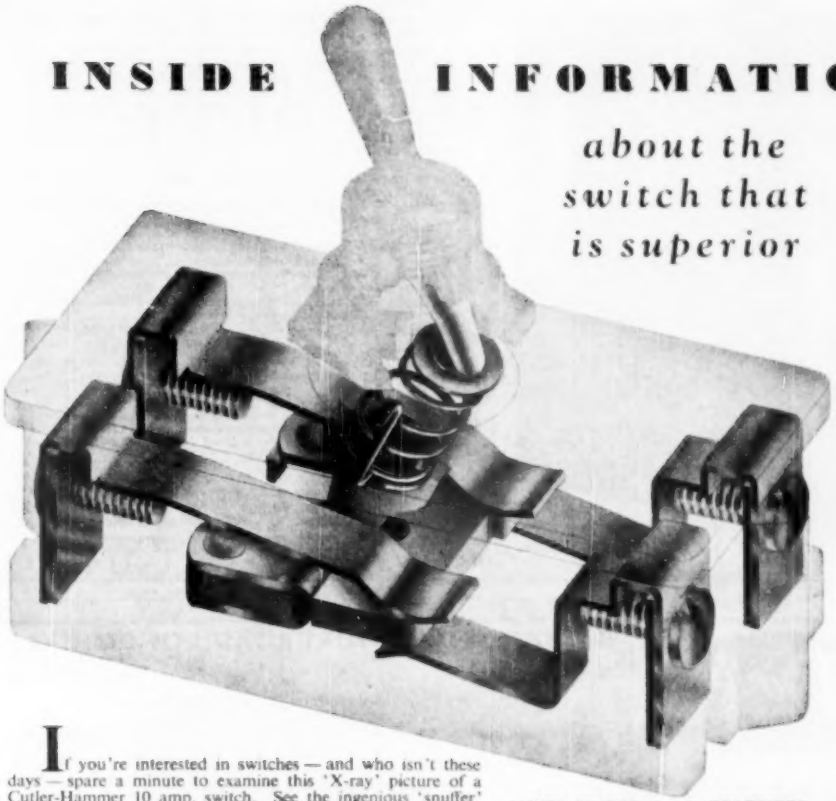
# INSIDE INFORMATION

*about the switch that is superior*



If you're interested in switches — and who isn't these days — spare a minute to examine this 'X-ray' picture of a Cutler-Hammer 10 amp. switch. See the ingenious 'snuffer' action — an original C-H feature — which eliminates pitting and arcing when breaking heavy loads. Note also that the silver alloy moving contact is self-aligning and self-cleaning. And finally observe the substantial area of the spring-leaf fixed contacts to ensure cool working.

Now if you're looking for a robust switch for a real job of work, here's the fellow to do it. May we submit samples and details of the wide range of operating mechanisms available?

**NOTE THESE C.-H. FEATURES**

**● Famous Cutler-Hammer "Snuffer" action ● Spring leaf fixed contacts ● Silver alloy Bridging contact ● Long helical actuating spring ● One piece moulded case ● Insulated toggle lever ● Large headed terminal screws ● Quick make and break mechanism.**

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**Other British N.S.F. products include: 'Oak' Rotary, Push-button and Slider switches; Carbon and wire-wound potentiometers for Television and Radio applications; Paper tubular capacitors; Wire-wound resistors.**

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APPLIANCE SWITCHES
C-H

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Subjective group listening tests carried out in direct comparison with live instruments under carefully controlled conditions.

Investigation covering 22 different directional characteristics with single and multiple point sources, with and without reverberation.

Investigation of various cabinet enclosures including the effects of such enclosures on middle as well as bass frequencies.

An investigation between large area plane wave sources and spherical wave point sources for the reproduction of various types of programme material.

Investigation into the subjective importance of phase shift in two unit systems.

The relative importance of damping, in particular with relation to twin unit systems with crossover.

The optimum apparent distance of sound source for various types of programme material

★ **Development . . .**

High frequencies radiated and reflected from above and behind to provide large area source on reverberant programmes yet retaining point source radiation from "dead" studio programmes.

The development of a high frequency ribbon unit giving aperiodic response from 2 k/cs to supersonic frequencies.

An extended bass response without deleterious effects at middle frequencies.

A directional characteristic which is effectively uniform yet retaining slight forward sense for realism in speech reproduction.

★ **Result . . .**

***A loudspeaker which is arousing tremendous enthusiasm among musicians and technicians alike and which we believe provides reproduction of the highest quality yet achieved.***

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Complete set of components for above amplifier including drilled chassis, cabinet, knobs, etc. Carriage free. £6 10 0.

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**Connoisseur Pick-up.** a high impedance pick-up giving approx. .5 volts at the secondary of the special coupling transformer. Level frequency response from 50 to 1,000 cps. Below 50 cps a rising frequency response gives a bass resonance near 25 cps. Above 1,000 cps the output falls steadily giving a loss of approx. 3 db at 8,500 cps and 9 db at 12,000 cps. Price complete with transformer incl. P.T. £4 10 5.

**Wilkins & Wright Pick-up.** A light weight moving coil pick-up with an overall response of 5 cps to 15,000 cps flat within 3 db from 30 cps to 9,000 cps. Coil impedance 3 ohms. Output impedance from special transformer 100,000 ohms. Approx. needle pressure ½ oz. adjustable within ¼ oz. to 1 oz. Price complete with transformer. £7 10 7.

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Connoisseur miniature needles 20 per pkt. 2 10.
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***Where excellent quality reproduction is essential . .***

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# AUDIO AMPLIFIER

***is the instrument to use***

This instrument is designed to give excellent quality reproduction with the added advantages of being a self-contained unit, portable and attractive in appearance. Thus it will prove ideal for Public Address work, educational authorities and similar organisations.

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|---|---|
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| **Input :** | Gramophone 0·2V for full output. Microphone 0·02V for full output. The two circuits can be mixed as required. |
| **Impedance :** | 7 ohms, 15 ohms and 45 ohms. |
| **Output :** | 20 watts with negligible distortion. |
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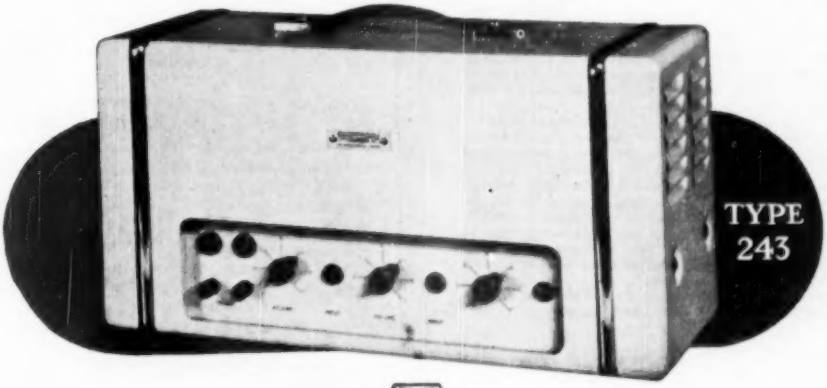
| **Response :** | ± 1 db from 30 to 15000 c/s at zero position of tone control. |
| **Controls :** | These are recessed to avoid damage and are illuminated when in operation. |
| **Dimensions :** | 18½" × 8½" × 10¼". |
| **Finish :** | The instrument is housed in an attractive steel case, stove enamelled in cream or blue as desired. A leather carrying handle is fitted. |

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Light Weight 36 lbs.

Negligible Stray Field.

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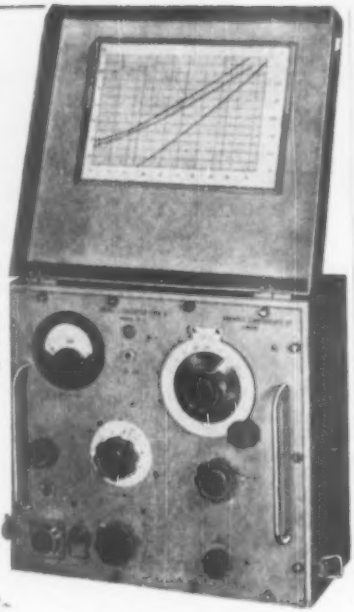
Dual-Power Supply 200-250v. 40-100 ~ 80-v. 40-2,000 ~



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This "ADVANCE" Signal Generator is of entirely new design and embodies many novel constructional features. It is compact in size, light in weight, and can be operated either from A.C. Power Supply or low-voltage high-frequency supplies.

An RL18 valve is employed as a colpitts oscillator, which may be Plate modulated by a 1,000-cycle sine wave oscillator, or grid modulated by a 50/50 square wave. Both types of modulation are internal, and selected by a switch. The oscillator section is triple shielded and external stray magnetic and electrostatic fields are negligible. Six coils are used to cover the range, and they are mounted in a coil turret of special design. The output from the R.F. oscillator is fed to an inductive slide wire, where it is monitored by an EA50 diode. The slide wire feeds a 75-ohm 5-step decade attenuator of new design. The output voltage is taken from the end of a 75-ohm matched transmission line.

The instrument is totally enclosed in a grey enamelled steel case with a detachable hinged lid for use during transport.

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|---|---|---|---|---|
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| B.1, C.1 ... ... | 10" & 12" | 5 | 5 | 0 |
| D.1 ... ... ... ... | 15" | 5 | 15 | 6 |
| A.3 (Universal) ... ... | 9" | 6 | 16 | 6 |
| B.2 (Universal) ... ... | 10" | 7 | 7 | 0 |
| C.1x ... ... ... ... | 12" | 7 | 7 | 0 |

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The Soundmirror is a high-fidelity Instrument which records and reproduces on reels of inexpensive magnetic tape Speech, Music, and every other sound audible to the human ear. Each reel gives a half-hour's uninterrupted playing. Short recordings can be cut and joined together. Playback is immediate. Recordings are permanent or if desired, can be automatically erased as new items are recorded.

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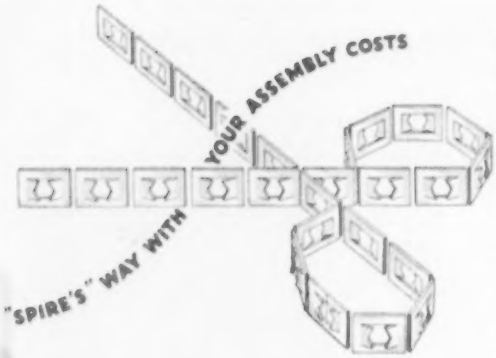


Assembly costs come down when you employ Spire Speed Nuts. They're so much easier and quicker to put on; such a saving in time, trouble and money. Spire hold tighter—it's the unique double-spring locking action that does it. Their large bearing surfaces are ideal for vitreous enamelled assemblies, glass, plastic, etc., to say nothing of just plain sheet metal. Engineers with assembly problems are invited to write for more information about Spire Speed Nuts—fastest thing in fastenings.

Spire SPEED NUTS

THAT'S FIXED THAT

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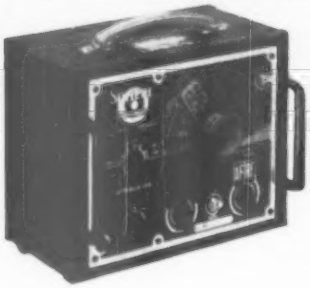

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**PRINCIPAL CHARACTERISTICS**

| | ME 1001 | ME 1003 |
|---|---|---|
| Heater Voltage (V) | 6.3 | 6.3 |
| Heater Current (A) | 0.4 | 1.0 |
| Max. Anode Voltage (V) | 350 | 600 |
| Max. Anode Dissipation (W) | 10 | 25 |
| Max. Anode Current (mA) | 50 | 200 |
| Max. Peak Anode Current (mA) | 150 | 500 |
| Power Output (W) | 0.5 (at 3000 Mc/s) 3.5 (at 500 Mc/s) | 6 (at 1500 Mc/s) 20 (at 430 Mc/s) |
| Mutual Conductance (mA/V) | 6 | 20 |
| Amplification Factor | 30 | 30 |

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MVT 64

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## CHARACTERISTICS & NOMINAL DIMENSIONS

| CHARACTERISTIC IMPEDANCE ohms | 50 Ω Coaxial | | 75 Ω Coaxial | | | 80 Ω Twin | | |
|---|---|---|---|---|---|---|---|---|
| SERVICE AREA .. .. .. | Local | Fringe | Local | Local | Fringe | Local | Local | Fringe |
| CODE NUMBER .. .. .. | K16M | AS93M | PT1M | K19M | AS60M | K20 | K12SM | BA24PSM |
| DESCRIPTION .. .. .. | Solid | Air Spaced | Solid | Solid | Air Spaced | Unscreened | Screened | Screened |
| CAPACITY μμF/Foot .. .. | 29 | 22.5 | 21.5 | 21.5 | 17 | 19.5 | 19 | 22 |
| Attenuation db/100ft. 1 Mc/s .. | 0.7 | 0.24 | 0.4 | 0.65 | 0.2 | 0.3 | 1.2 | 0.5 |
| 45 " .. | 4.8 | 1.7 | 2.6 | 3.7 | 1.5 | 2.1 | 5.9 | 2.5 |
| 100 " .. | 7.1 | 2.6 | 4.2 | 5.7 | 2.4 | 3.2 | 7.5 | 3.6 |
| Diameter in inches :— | | | | | | | | |
| Over Copper Conductor .. | 7/0.0076 | 7/0.022 | 0.022 | 7/0.0076 | 0.048 | 0.036 | 0.029 | 0.048 |
| " TELCOTHENE .. | 0.085 | 0.180 | 0.128 | 0.128 | 0.200 | — | 0.070 | 0.088 |
| " Twin Cores .. .. | — | — | — | — | — | 0.19 x 0.1 | 0.140 | 0.200 |
| " Wire Braid .. .. | 0.109 | 0.210 | 0.152 | 0.152 | 0.230 | — | 0.180 | 0.237 |
| " TELCOVIN Sheath .. | 0.159 | 0.275 | 0.202 | 0.202 | 0.300 | — | 0.232 | 0.297 |

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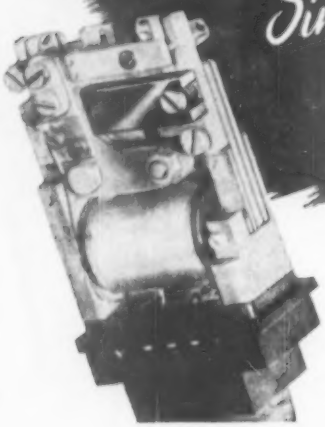

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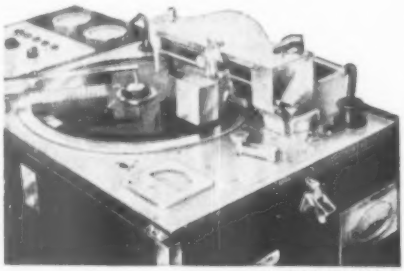

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|---|---|
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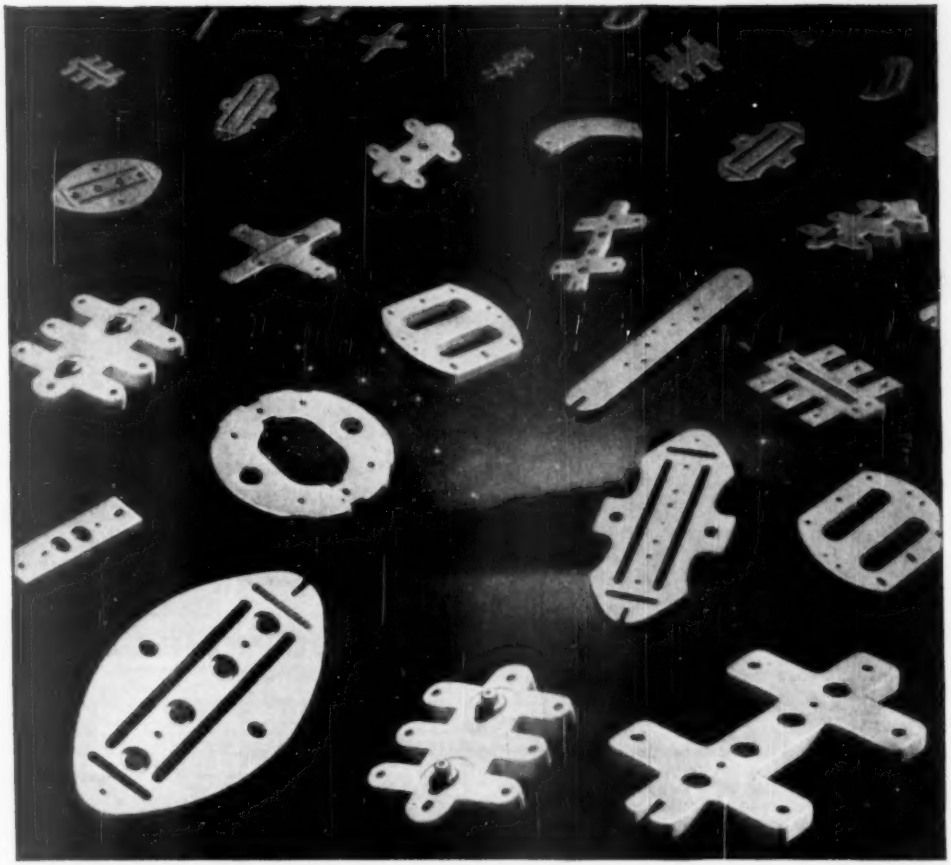

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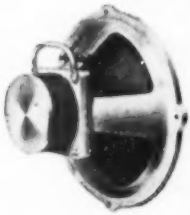

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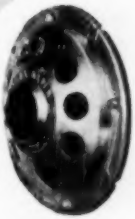

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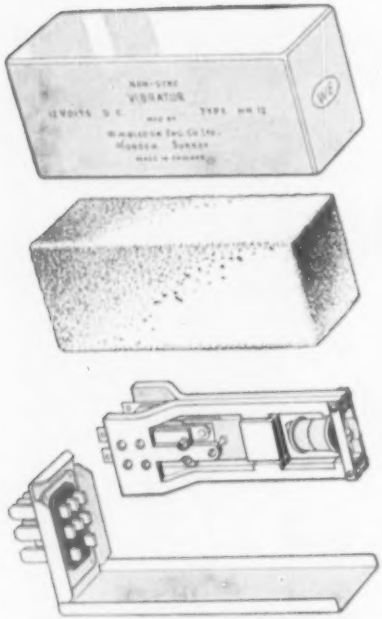

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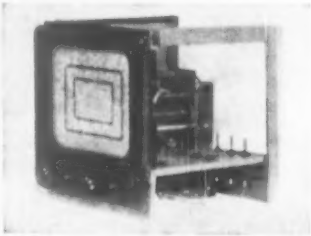

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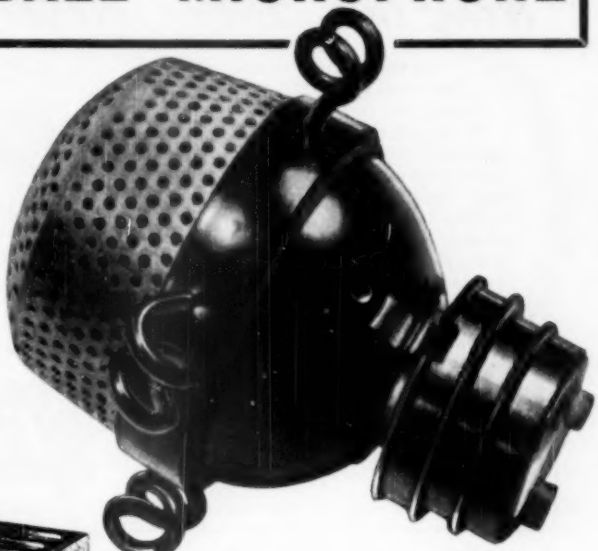

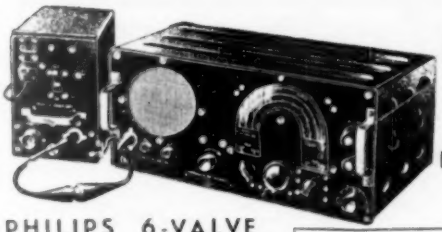

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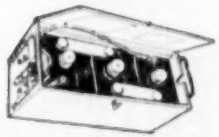

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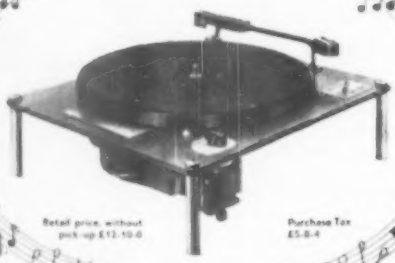

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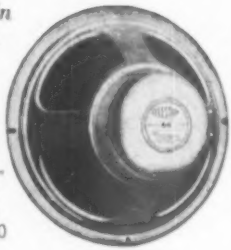

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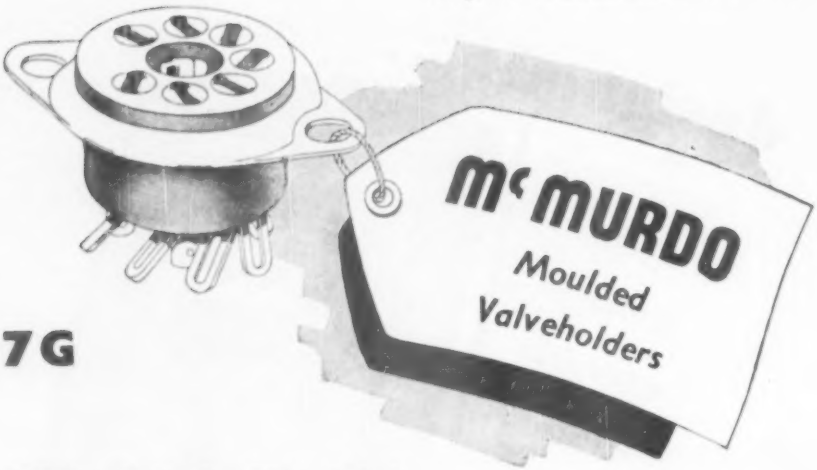


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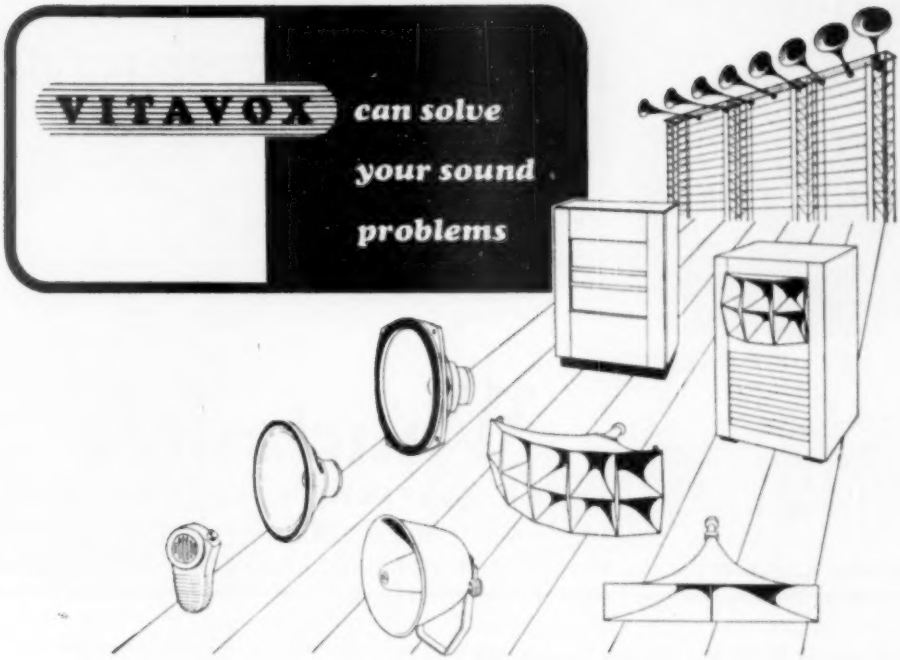


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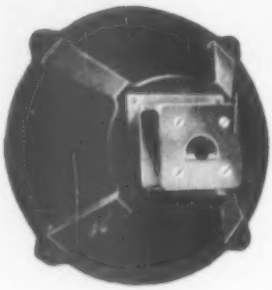

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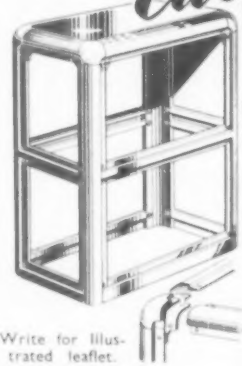

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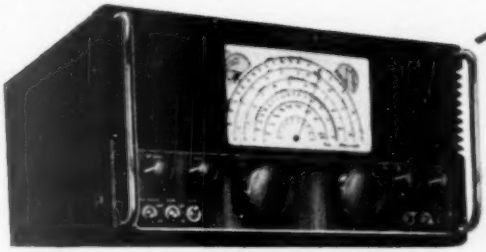

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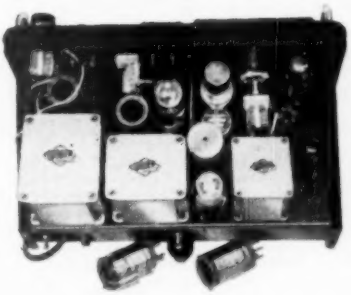

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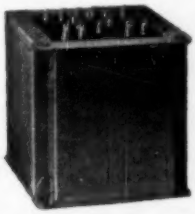

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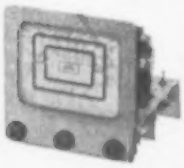

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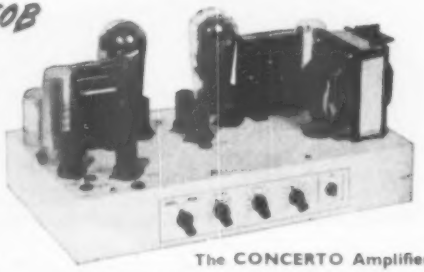

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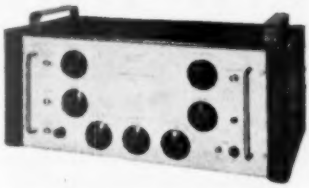

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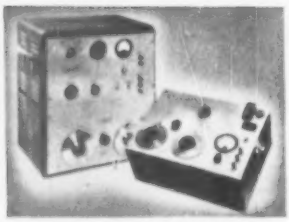

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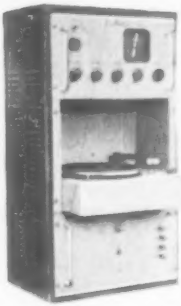

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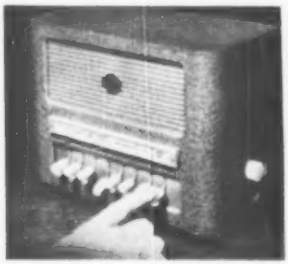

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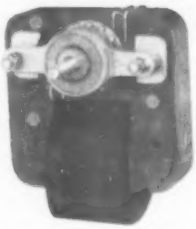

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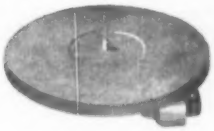

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# Wireless World

RADIO AND ELECTRONICS

February 1950

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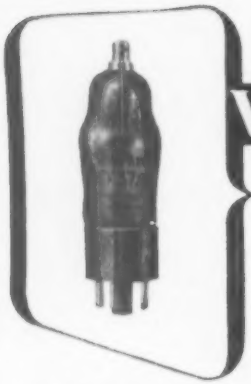
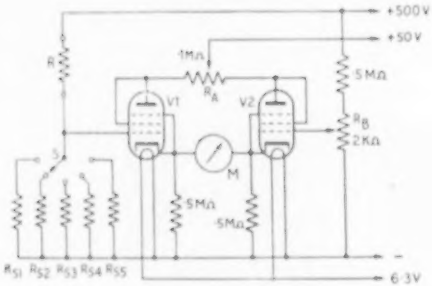


# Valves and their applications

## USE OF EF37A TO MEASURE HIGH RESISTANCE

The measurement of resistances of many millions of megohms generally involves the use of a special valve such as an electrometer triode. When the resistance to be measured is somewhat lower, say below one million megohms, a much simpler arrangement is possible and a conventional valve may be used provided its input impedance is sufficiently high. A suitable circuit for this purpose is shown below:




The circuit is essentially a bridge. The reference resistors $R_{51}$, $R_{52}$, $R_{53}$ . . . may for convenience be made equal to 1,000, 10,000, 100,000 . . . $10^9$ ohms; they are selected by means of a high-grade switch S, preferably ceramic-insulated. Both valve grids are initially earthed by means of a further bank on switch S (not shown) and the potentiometer $R_A$ is adjusted to give zero current in the microammeter M. Switch S is then set so that the grid-to-ground resistance $R_B$ of $V_1$ is of the order of one-thousandth of the resistance R to be measured. By this means a voltage of between 0.15 and 1.5 volts is applied to the grid of $V_1$ and by setting $R_B$ to the appropriate value a balance will again be obtained. If the potentiometer $R_B$ is suitably calibrated it will then be possible to read off the value of R as the product of the reading of $R_B$ and the value of $R_S$.

The simplicity of the arrangement will be apparent. Its usefulness is, however, restricted by the fact that for large values of $R_S$ grid current flowing in V1 may disturb the calibration. In order to minimise this effect it is convenient to use a valve such as the EF37A whose grid-current is low and to select suitable operating conditions. Using EF37A's in the circuit shown, this grid-current is a negative current (electrons flowing from grid to cathode within the valve) and is made up of

(1) ionisation current

(2) grid emission

(3) leakage currents

Ionisation current increases with anode current and also with the velocity of the electrons constituting the anode current, i.e. with anode voltage. It is therefore desirable for V1 (and also V2) to operate at low anode current and voltage. Grid emission results largely from the fact that the grid is warmed by the neighbouring cathode, and is dependent on cathode temperature, proximity of control grid, etc. Leakage currents may occur either inside or outside the glass envelope; from the standpoint of internal leakage it is again desirable to work at low voltages while insofar as external effects are concerned it is important to ensure that the surface of the glass is kept clean and dry.

The requirements outlined in the last paragraph are largely satisfied by the circuit shown. Furthermore, a special version of the type EF37A is available which operates at low heater voltage and, consequently, low cathode temperature. Using this valve under the above conditions the grid current is less than ten micro-microamps. This valve is known as type ME 1400.

A D.C. amplifier may be used between the bridge circuit and the meter. This gives increased accuracy and permits the use of a robust and inexpensive meter. With such a circuit measurements can be made up to one million megohms with somewhat lower accuracy.

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*Reprints of this report together with additional circuit notes are available, free of charge, from the address below.*

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(MVM 119)

Wireless World

VOL. LVI. No. 2. FEBRUARY, 1950

# Growth of Television

THE new B.B.C. television transmitter at Sutton Coldfield may now fairly be hailed as a success, and everyone concerned with its design and construction is to be congratulated. The initial breakdowns may, it is fair to assume, be attributed largely to the initial difficulties that might reasonably be expected to arise from the high power of the transmitter—the highest power yet used for television and, indeed, exceptionally high power for any form of e.h.f. transmitter on comparable frequencies. Range has proved to be considerably greater than early official estimates would suggest and, over the densely populated area immediately surrounding the station, signal strength is so tremendous that good pictures are receivable on the simplest and cheapest installations. The method of feeding picture modulation to the transmitter by means of a radio link has proved entirely successful, and viewers in the Midlands are under no disadvantage as compared with those around London: there is certainly no detectable deterioration as a result of relaying.

On the broader issue, much encouragement can be taken from this first step in spreading television over the whole country. The basic standards chosen for our system, the method of distributing a single programme and the relatively austere nature of our projected national service all fit in well with the present economic position. Receivers for our medium-definition system can be manufactured at a price which brings them into the mass market—an essential for the growth of television—while the radio-frequency bandwidths required are of reasonable width, thus simplifying at least some of the problems of distribution.

There has been some dissatisfaction at the tardiness of putting into effect this first step in serving the provinces with television. Now that the ice has been broken, we hope development will proceed in a rapid and orderly manner—just as fast as sets for would-be viewers can be made and ancillary requirements—such as the training of technicians for installation and maintenance—can be met.

# Vicissitudes of "Electronics"

A CONTROVERSY has arisen in the U.S.A. on the origin of the word "electronics" and also of its adjective, "electronic," and it is suggested there that the former word was used in England long before 1929, which is the critical date for the American discussion.

This is an argument to which we find it difficult to contribute anything helpful to the participants. There is no doubt that Johnstone Stoney in the last century coined the word "electron" to describe an elementary electrical particle; it seems safe enough to guess that "electronic" appeared soon afterwards as the adjectival form. It is rather less safe to guess, though it is possibly true, that at about the same time the word "electronics" was used to describe the science of electricity according to the electron theory.

But all this does not get us much further, as we cannot trace in this country any early use of the word "electronics" in the restricted sense rather arbitrarily later ascribed to it somewhere. The official American definition nowadays is "that branch of science and technology which relates to the conduction of electricity through gases or *in vacuo*."

We are interested to see that the Americans confine their controversy to the origin of the word; happier than us, they seem to be in no doubt as to what it means. Here, we regret to observe, it tends to become rather meaningless, and, unless we are careful, will become just another catchword like "streamlined." Perhaps the most popular definition of "electronics" at the moment is "radio techniques as applied to non-communication uses," but there are plenty of others. Perhaps that is why wise practitioners in the art now tend to be shy of the word, restricting its use to contexts where they feel the meaning will be clear.

The 750-ft mast of the Sutton Coldfield station carries eight dipoles at the extreme top which radiate both sound and vision. The lower tubular section, between the dipoles and the lattice structure is a "slot" radiator intended for future v.h.f. broadcasting.

# Television Station

## *Details of the New Transmitter*

THE Sutton Coldfield television transmitter, which was officially opened on 17th December, has a peak power of 35 kW and is claimed to be the largest in the world. Situated about eight miles north of Birmingham the station is some 500 ft above sea level and is provided with a 750-ft mast to bring the aerial system 1,250 ft above sea level.

The mast is of triangular section with 9-ft sides for the first 610 ft. Above this it is circular for another 100 ft and this part contains a slot aerial system intended for future v.h.f. broadcasting. The television aerials are higher still and comprise eight folded dipoles arranged in two tiers of four each. All dipoles are common to both sound and vision channels.

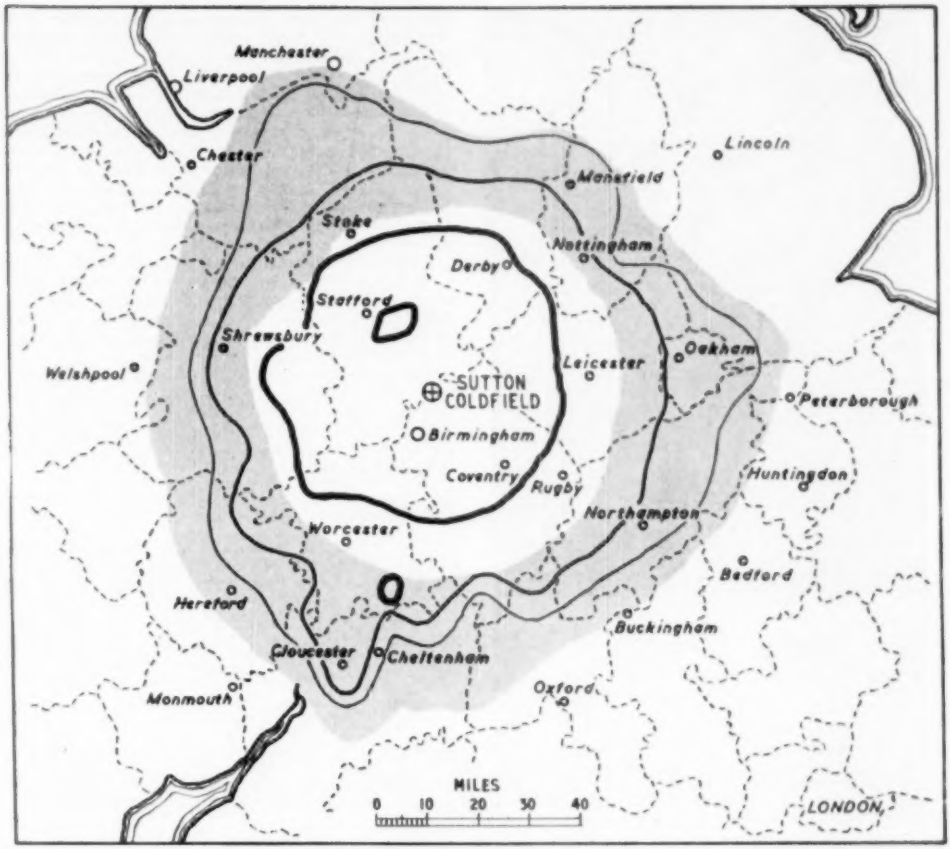
A lift is provided in the mast up to 610-ft level. In order to permit angular movement in wind the mast rests on a steel ball and is supported by four sets of stays. It was designed and constructed by British Insulated Callender's Construction Co., and the topmast and aerials were made by Marconi's W. T. Company.

The separate transmitters for sound and vision together with their ancillary equipment are contained in a single-storey building. The sound transmitter, by Marconi's W.T. Company, is of 12-kW average carrier power output at 58.25 Mc/s with class B anode modulation of the output stage. The drive unit is followed by three push-pull amplifier stages. The final stage is a single BR128 valve in an earthed-grid coaxial-type circuit, the output being fed through a concentric feeder to the aerials. Air cooling is used for the valves.

The vision transmitter provides up to 35 kW peak power with a carrier frequency of 61.75 Mc/s. It was constructed jointly by E.M.I. and Metropolitan-Vickers, the latter firm being the sub-contractors for the major part of the radio-frequency equipment. On the r.f. side the transmitter starts with an r.f. drive unit, supplied by Marconi's W.T. Company, similar to that used for the sound channel; it contains a crystal oscillator and two stages of frequency multiplication. This is followed by a three-stage low-power amplifier beginning with a single-valve pentode followed by a push-pull tetrode stage and ending with a pair of triodes in push-pull in the earthed-grid connection.

The driver stage, following this, has two ACT26 triodes operating as a class C neutralized push-pull amplifier. The final stage uses CAT21 triodes in an earthed-grid circuit with parallel-line circuit elements and it feeds the output coaxial-line feeder. This stage is grid modulated

This photograph shows the r.f. side of the vision transmitter with the waveform monitor in the foreground. The power supply is in a room immediately behind the transmitter.




This map of the service area of the Sutton Coldfield transmitter is based on calculation and indicates the strength of signal to be expected on theoretical grounds. The heavy contours are for field strengths of 5 mV/m, the medium 500 μV/m, and the light 100 μV/m; the figures are for peak-white transmission and a receiving aerial 30 ft above ground. In the shaded zone satisfactory reception will be subject to favourable local conditions and some fading may be experienced at times; beyond the shaded zone consistent reception cannot be expected. The service area which will actually be obtained cannot be known until the station has been in operation for some months, but the preliminary reports during the first weeks indicate that it is likely to be much greater than this map depicts.

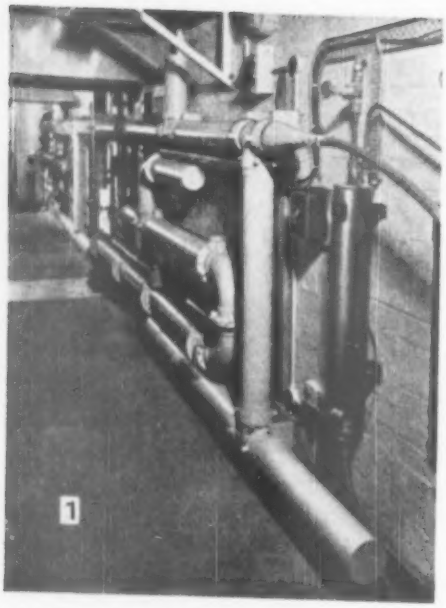
by the vision signal. This final stage is water cooled, but the others are all air cooled.

The vision signal enters the station through a cable link by which it is conveyed from the terminal station (in Birmingham) of the London-Birmingham radio link. The signal has an amplitude of about 1 V and is applied to a pre-amplifier which is arranged to have an adjustable curvature of its input/output characteristic. This amplifier also enables the relative amplitudes of the picture signal and the sync pulses to be controlled.

Further amplifiers are designated the sub-sub-modulator and the sub-modulator, a black-level clamp being provided between the two. The modulator is a cathode follower using four valves in parallel. It gives no voltage amplification, but has a sufficient power output at very low impedance to supply the 3.5-A grid current of the final r.f. stage as well as the large capacitive current which it demands. ACM3 valves are used throughout the modulators and are air-cooled.

The transmitter output is taken through a coaxial line to the vestigial-sideband filter. It is of the constant-resistant type and includes a high-pass and a low-pass section constructed of coaxial line. The output of the l.p. section is taken through a coaxial line to the aerial, this line forming the termination of the filter. The high-pass section, however, is terminated by a water load in which the power of the unwanted sidebands is absorbed.

The filter transmits the lower-frequency sidebands to the aerial but increasingly attenuates the upper



(1) The vertigial-sideband filter is of the constant-resistance type with high- and low-pass sections. It is constructed of coaxial lines and the power from the unwanted sidebands is absorbed in a "water load."

sidebands for vision frequencies above 0.75 Mc/s. At 63.25 Mc/s, the sound channel of an adjacent future television station, the attenuation is 12 db.

The r.f. outputs from the two transmitters are taken up the mast in separate coaxial feeders. They are of 5-in outside diameter and 51-Ω impedence. They are made in 12-ft sections and expansion joints are fitted every 150 ft to allow for temperature changes. Dry air is blown continuously through them to prevent condensation. In order to facilitate adjustment and testing, the vision transmitter output can be switched to a water load in which the power is then dissipated and measured.

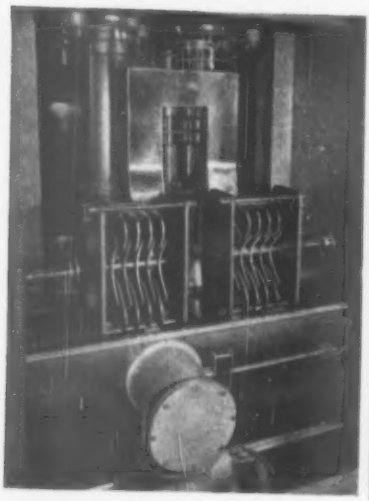
Towards the top of the mast the feeders terminate in a diplexer. This is a device which combines the sound and vision signals and at the same time prevents power from one feeder from being fed down the other. It is the equivalent of the hybrid transformer so widely used in a.f. lines technique.

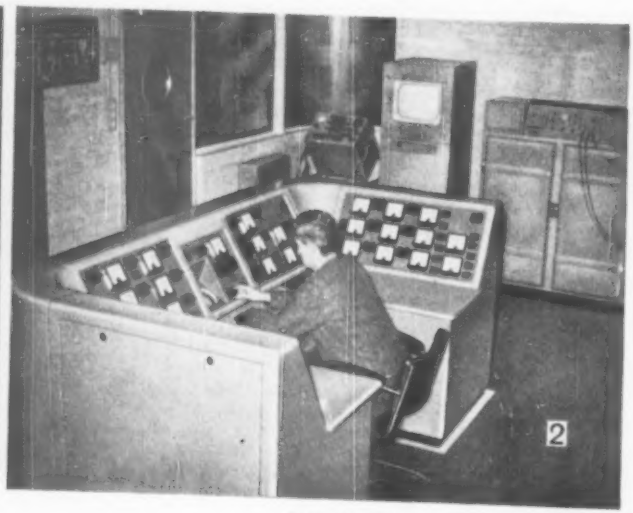
The combined signals in the output of the diplexer are taken through feeders to a pair of unbalance-to-balance transformers and thence by two pairs of coaxial feeders to the aerials. One pair feeds the north-south dipoles in each tier and the other the east-west dipoles.

## The Aerials

Phase shifts are introduced into the dipole feeds and in the opposite sense for the sound and vision signals. Clockwise from north the vision signal in both tiers is phased 0°, 90°, 180°, 270°, while the sound is phased 0°, 270°, 180°, 90°. The aerial gain in a horizontal plane is 4 db. The dipoles themselves are made from 10-in galvanized steel strip; 7.5-kW heaters are fitted to prevent ice formation.

(2) The photo on the left shows the interior of the final stage of the vision transmitter. The vertical tubes form the anode tuning inductances and are mounted below the CAT21 valves. The output circuit tuning capacitors are visible in the front above the output feeder. The photo on the right shows the control desk for the sound and vision transmitters; it includes a c.r. wave-form monitor tube. Picture-monitor tubes are provided and the control room has windows looking into the transmitter hall.





The transmitting equipment is rack-mounted and the racks are assembled in line against one wall of the transmitter hall. On the other side of this wall the power-supply apparatus is fitted, the connections passing through the wall and being consequently quite short. Hot-cathode mercury-vapour rectifiers are used for the vision transmitter and the supply at 415-V 3-phase is stabilized and phase-balanced by three moving-coil voltage regulators. The smoothing circuit for the final stage is built out to a low constant resistance and the high-voltage anode supplies for the other stages have valve stabilizers.

### Voltage Control

A.C. heating is used for the valve filaments except in the modulated stage, where a d.c. supply from a motor generator is used. An electronic regulator is employed to keep the voltage within 0.1 per cent of its nominal value. The power is derived from the grid system at 11 kV and transformed to the 415-V used in the building. An emergency lighting system at 240 V from batteries is provided.

The equipment for cooling is located between the two power-supply rooms for the sound and vision transmitters. The heated air can be switched into the main building for space heating in winter.

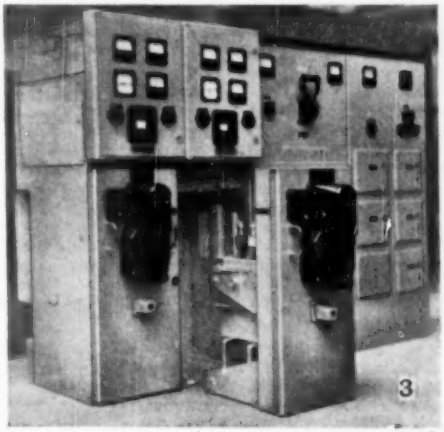
Looking into the transmitter hall is the control room in which a control desk enables one man to operate both transmitters. In addition to meters, a c.r. tube is provided as a waveform monitor and there are picture monitor tubes to show both the incoming signal and the radiated signal. A diagram with 200 miniature lamps provides a tell-tale; the lamps light in turn as the supplies to each stage are established.

The station contains no studio since it is intended to be fed normally by a picture originating in London. When local programmes are required the standard outside-broadcast equipment is to be used. A film-scanner is provided, however, and its purpose is mainly to provide a source of programme in the event of a breakdown in the link to London.

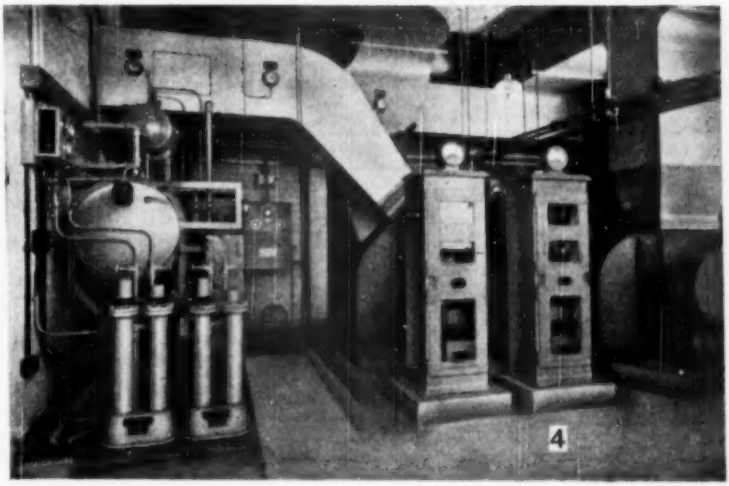
## ITALIAN TELEVISION TESTS

WE learn from our Italian contemporary *Elettronica and Televisione* that tests have recently been concluded in Italy with both French and American television equipment preparatory to starting a service. The transmitters were erected by the Italian broadcasting authority on a 700-metre hill in the vicinity of Turin and receivers were installed in public buildings in a number of towns.

The American equipment, which operated on 83.25 Mc/s (vision) and 87.75 Mc/s (sound), was built to U.S. standards—with negative modulation and the lower sideband suppressed—except that the scanning rate was 625 lines with 25 frames instead of 525 with 30 frames. Sound was frequency modulated. The French transmitter employed the new 819-line standards of the projected French system.



(3) Power switchgear for the transmitters supplied by Brush Electrical Engineering.



(4) The cooling plant is shown in this photo. On the left is part of the water-cooling equipment for the final stage of the vision transmitter. The other valves are air-cooled and the heated air can be utilized, if required, for heating the building.

# New Sub-miniature Valves

## *"Flat" Types with Filaments Drawing Only 15mA*

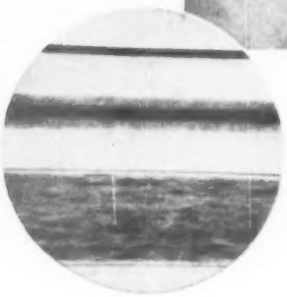
By C. C. GEE (*Mullard Electronic Products*)

IN the March, 1948, issue of *Wireless World* an account was given of a series of 10-mm sub-miniature valves which were specially developed by Mullard for use in the National Health Hearing Aid, "Medresco." These valves, which had 25-mA filaments, compared favourably in performance with corresponding valves of American manufacture, and fully met the requirements of the specification laid down by the Post Office Research Station. However, from the very onset of the development of these valves there was a pressing demand for still smaller types, of flat construction, having even lower filament currents.

The new series of flat sub-miniatures, represented by the Mullard voltage-amplifying pentode DF66, and the output pentode DL66, meet this demand, and mark a notable advance in valves specifically designed for hearing aids. As a result of this development, it will be possible to reduce still further the size and weight of these instruments, and at the same time extend the life of the batteries. It is claimed that the new valves will not only satisfy the requirements of manufacturers of hearing aids in this country, but will also be able to compete on very favourable terms with American types in the world market.

Some idea of the rapid progress that has been made in the development of hearing aid valves during the past thirteen years may be gathered from Table I. From the table it will be seen that the volume of the new voltage-amplifying sub-miniature DF66 is less than one-twelfth that of the Mullard DA1, introduced in 1936; moreover, the filament current has been reduced from 50 mA to 15 mA. Comparing the DF66 with its equivalent 10-mm type, DF70, it will also be noted that not only has the volume been reduced but, as a result of the flat type of construction, there has been a marked reduction in the cross-sectional area. The importance of this in the design of extremely compact hearing aids may be judged from the fact that the total cross-sectional area enclosed by three of the new valves is only 156 sq mm (0.24 sq in) as against 234 sq mm (0.36 sq in) for three of the 10-mm type sub-miniatures. This results in approximately a two-thirds saving in space. Three of the latest flat-type American valves similarly placed enclose a cross-sectional area of 213 sq mm (0.33 sq in). This means that the space saved by using the new British valves in place of equivalent American types amounts to over a quarter.

The Mullard type DF66 valve fitted into a standard sub-miniature holder.



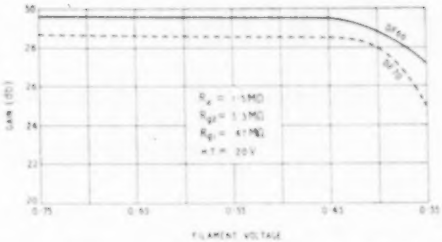
Uncoated and coated filament of the Mullard DF66 flat sub-miniature valves compared with a human hair.

**TABLE I**

| | DA1 Voltage-amplifying triode | DC51 Voltage-amplifying triode | DF70 Voltage-amplifying triode | DF66 Voltage-amplifying triode |
|---|---|---|---|---|
| Year introduced ... | 1936 | 1939 | 1947 | 1949 |
| Overall length (mm) (in) | 60<br>2.36 | 62<br>2.44 | 29.5<br>1.16 | 27<br>1.06 |
| Overall dia. or (mm) cross-section (in) | 19<br>0.74 | 17<br>0.66 | 10<br>0.39 | 8.3 × 6.1<br>0.32 × 0.24 |
| Volume ... ($mm^3$) ($in^3$) | 17,000<br>1.04 | 14,100<br>0.87 | 2,320<br>0.141 | 1,400<br>0.085 |
| Cross-sectional area. ($mm^2$) ($in^2$) | 280<br>0.43 | 225<br>0.34 | 78<br>0.12 | 52<br>0.08 |
| Filament current (mA) ... ... | 50 | 67 | 25 | 15 |

### Filament Diameter

The low filament current of the new valves has been obtained through the use of highly emissive, oxide-coated filaments, having a tungsten core of no more than 7.8 microns (3/10,000th in) diameter. The remarkable precision of the tungsten wire and the uniformity of the oxide coating is apparent from the photograph, which shows the coated and uncoated filaments scaled against a human hair. From this it is estimated that the tungsten wire is less than




**Typical curves showing gain in relation to filament voltage for the DF70 and DF66 type valves.**

1/10th as thick as the hair, whilst the coated filament is less than 1/3rd as thick.

In spite of the extreme fineness of the filament wire, it has been found possible to produce the filaments on a mass-production basis on conventional filament-making machines. During all stages of manufacture, every precaution is taken to ensure the highest possible standards of purity and surface smoothness of the wire. Extreme care is also taken in the coating of the wire, in order to ensure stable emission.

## Sealing Technique

The special sealing technique employed in the production of these valves is such that the heat is directed away from the electrode assembly during the sealing process. In this way the problem of electrode poisoning and distortion is largely overcome. It is this sealing technique which makes possible the use of extremely fine filaments. Since in this method the envelopes are sealed directly to the glass bases, it has also been possible to reduce the length of the valves.

Another important feature is freedom from microphony. This has been achieved by reducing the length of the electrode system and improving the methods of springing. As a result of this the fundamental frequency of the filament of the DF66 has been raised to about 6,000 c/s. This is far above the upper frequency limit of 4,000 c/s specified for most hearing aids at present in use.

The lead-out wires in these valves may be either soldered directly to the circuit components, or may be cut back to about ¼in. and fitted into standard sub-miniature sockets as shown in the photograph.

It would normally be expected that the reduction in filament current from 25 mA to 15 mA, which has been achieved in these new valves, would result in a considerable reduction in the gain. This, however, has been offset by a marked improvement in the design of the grids. By using fine wire and by taking extreme care in the symmetry of the electrode assembly, it has, in fact, been possible to improve the gain of the DF66 voltage amplifier by one or two db compared with the 10-mm type DF70. Moreover, as shown by the gain curves, the fall of the gain with decreases in the filament voltage is not quite so rapid in the DF66. This means that even when the voltage of the l.t. battery is reduced from its normal 1.25 V to 0.8 V the response of the hearing aid circuit can be maintained at a reasonably high level.

On account of their small size and low filament current, these new valves should prove of particular value in the design of hearing aids in which both the l.t. and h.t. batteries are housed in the case of the instrument. It is estimated that instruments of this kind having a nominal output of about 2.5 mW should meet the requirements of over 70 per cent of those suffering from defective hearing. Using two DF66 voltage-amplifying pentodes in series, feeding into a single DL66 output pentode, it should be possible to produce hearing aids weighing less than 5 ounces. These could be easily concealed about the person of the wearer, so as to be almost indetectable. By using l.t. cells of the mercury type, it is probable that such instruments would give over 50 hours of useful service before it is necessary to replace the l.t. battery. A similar instrument embodying one of the ordinary leclanché-type cells should give over 12 hours of continuous use.

With the introduction of these new flat sub-miniatures it appears that the reduction in size of valves of this class has almost reached its limit. Future developments will possibly be in the direction of even lower filament currents and higher gains. As a result of these improvements it should be possible to extend still further the life of hearing aid batteries, or, conversely, reduce their size for a given life period. It will be realized that this is the most practical way of designing smaller lightweight hearing aids when it is considered that, in such instruments, it is the batteries which account for a large percentage of the size and weight.

It is interesting to note that, parallel with this development, Mullard are bringing out a complete range of both battery and mains 10-mm sub-miniatures for use in miniature communication equipments, and other compact, lightweight electronic units.

**TABLE II**

*Principal Characteristics Compared*

| | 10-mm Sub-miniatures | | Flat Sub-miniatures | |
|---|---|---|---|---|
| | DF70 Voltage-amplifying pentode | DL71 Output pentode | DF66 Voltage-amplifying pentode | DL66 Output pentode |
| $V_f$ (V) ... ... | 0.625 | 1.25 | 0.625 | 1.25 |
| $I_f$ (mA) ... ... | 25 | 25 | 15 | 15 |
| $V_a$ (V) ... ... | 30 | 45 | 22.5 | 22.5 |
| $V_{g2}$ (V) ... ... | 30 | 45 | 22.5 | 22.5 |
| $V_{g1}$ (V) ... ... | 0 | −1.25 | −1.05 | −1.4 |
| $I_a$ (mA) ... ... | 0.375 | 0.6 | 0.05 | 0.3 |
| $I_{g2}$ (mA) ... ... | 0.125 | 0.15 | 0.015 | 0.075 |
| $g_m$ mA/V ... | 0.22 | 0.55 | 0.1 | 0.35 |
| $P_{out}$ (10% distortion) (mW) ... ... | — | 6 | — | 2.5 |

# Output Impedance Control

*Variable Loudspeaker Damping Without Alteration of Output Level*

By THOMAS RODDAM

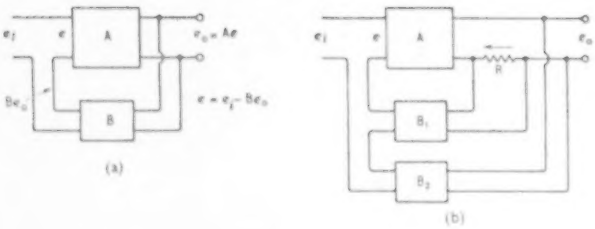
WHENEVER the Editor feels rather lonely in his eyrie overlooking the South Bank, and wants readers to write to him, he publishes an article on the loudspeaker damping problem. As the best "damping factor" depends on the loudspeaker design, letters pour in, and he feels that it must be Christmas again. Although no one seems to have used this simile, the choice of a damping factor is very much like the adjustment of a swing door: with too little damping the door swings to and fro several times after it is released; with too much damping it shuts very slowly, leaving a most unfriendly draught blowing for some seconds after each person comes in. The loudspeaker cone behaves in the same way: too little damping and it oscillates on its own whenever it receives a shock; too much, and transients are lost completely. At this point the usual thing is to jump in and quote a magic figure for damping factor, which will solve all problems. I don't propose to do this, because I'm pretty certain that all types of loudspeaker require different answers. Some, I suggest, are like galvanometers I have encountered, and need negative resistance to provide critical damping.

The obvious thing to do is to change the damping factor until it sounds right. There are rather more complicated ways of checking the damping factor, but if you can't hear the difference, why worry; your friends won't be impressed. In this article I shall show how an amplifier can be constructed with a variable output impedance, with the rather important feature that as you vary the impedance the output stays the same. You can alter the impedance with a signal on and listen to the effect, without any disturbing level changes or distortion; the distortion actually varies slightly, but it is low enough to be disregarded anyway. The impedance can be brought right down to zero, or even made negative, but of course if the negative output impedance is bigger than the load the amplifier becomes an oscillator: this effect is easily detected by the pragmatic test: you can hear it!

I shall assume that the reader has a file of back numbers of *Wireless World* and that before he goes any further he will read "Cathode Ray's" article in the February 1946 issue. In this, the effect of negative feedback on the output impedance of the amplifier is explained. Summarizing, negative voltage feedback reduces the output impedance, while negative current feedback increases it. By applying the reasoning which leads to these results it is easy to show that positive current feedback will reduce the output impedance. We therefore have two ways of reducing the impedance, one of which, negative feedback, is very commonly used. Within certain limits we could use only negative feedback, but the disadvantage for our present purpose is that as we alter the feedback we alter the overall gain of the amplifier. This does no harm if we are adjusting the circuit once for all, but if we are studying the way different damping factors sound, it is not desirable to have to adjust the level each time we change the impedance. In addition, we are restricted in the range over which the impedance can be adjusted.

Writing A for the voltage amplification without negative feedback, and B for the fraction of the output voltage fed back, the gain of the amplifier is $A/(1 + AB)$ with feedback. So long as A is large we can take $(1 + AB) \simeq AB$, and the gain as just $1/B$. This is a good approximation in most practical cases: for example, in a two-stage amplifier we may have $A = 1{,}000$ and $B = 1/100$, giving $AB = 10$. The voltage amplification is then exactly 90.1, or approximately 100, a difference of only 0.9 db. If A increases to 4,000, the gain increases to 97.7 times, or by 0.7 db. Thus by using enough feedback to reduce the gain 20 db we keep the gain constant within $\pm \frac{1}{2}$ db however we increase A.

We can make use of this by applying negative



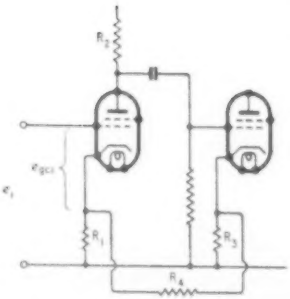




Fig. 1. (a) Normal connections in a negative voltage feedback amplifier. (b) Mixed voltage and current feedback. Fig. 2. (right) Basic positive feedback circuit.

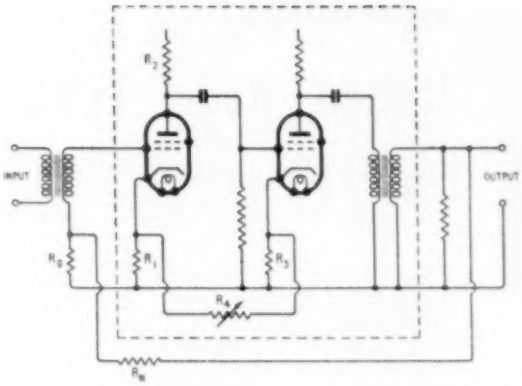



Fig. 3. Combined feedback circuit of amplifier with variable output impedance. $R_4$ is the control; suitable values are suggested in the text.

feedback round the whole amplifier, and at the same time putting positive current feedback round an inner loop. Fig. 1 shows a normal negative voltage feedback amplifier and an amplifier having two feedback paths, $B_1$ for current feedback and $B_2$ for voltage feedback. For this amplifier the input voltage $e$ will be $e_i + B_1 iR - B_2 e_o$, where $B_1$ is the positive current feedback path and $B_2$ the negative voltage feedback path. I shall not develop the equations, because this particular arrangement is easily seen to be inconvenient as soon as earths are to be applied to the circuit. Instead, let us consider the circuits of Fig. 2.

## Design Relationships

In this two-stage pentode amplifier, the first valve has a mutual conductance $g_1$, and the second $g_2$. The current in the anode load of the first valve will be $g_1 e_{gc1}$, producing a voltage at the grid of the second valve equal to $-g_1 e_{gc1} R_2$. For this valve, we have $e_{gc2} = -g_1 e_{gc1} R_2 - g_2 e_{gc2} R_3$ giving

$$e_{gc2} = -\frac{g_1 e_{gc1} R_2}{1 + g_2 R_3}$$

Across the cathode load $R_3$ we have a voltage $g_2 e_{gc2} R_3$, of which a fraction $R_1/(R_1 + R_4)$ appears across the cathode resistance of the first valve, so long as $R_4$ is much larger than $R_2$. The input voltage $e_1$ required to produce the grid-cathode voltage $e_{gc1}$ is therefore

$$e_1 = e_{gc1} + e_{gc1} g_1 R_1 - \frac{R_1}{R_1 + R_4} \cdot \frac{g_1 e_{gc1} R_2}{1 + g_2 R_3}$$

We can have a finite value of $e_{gc1}$ for $e_1 = 0$ by making

$$1 + g_1 R_1 = \frac{R_1}{R_1 + R_4} \cdot \frac{g_1 R_2}{1 + g_2 R_3}$$

This means that we have infinite gain, which is the condition for zero impedance to appear at the anode of $V_2$. To simplify this expression, let us take $g_1 = g_2$, $R_1 = R_3$ and $g_1 R_1 = g_2 R_3 = 1$, with $g_1 R_2 = 100$.

Then

$$\frac{R_4}{R_1} + 1 = \frac{1}{2} \cdot \frac{100}{2} = 25$$

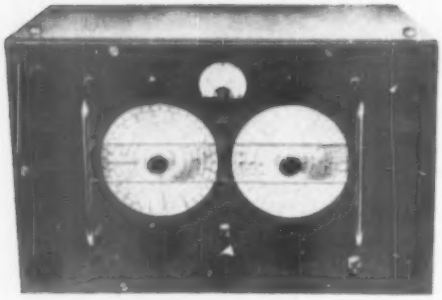
or $R_4 = 24 R_1$

Now let us look at Fig. 3. If this is compared with the top diagram in Fig. 1 it will be seen that the circuit inside the dotted box is simply an amplifier A, and the B circuit is now $R_g$ and $R_N$, with a value of $B = R_g/(R_g + R_N)$ or $\simeq R_g/R_N$. As we saw, we can increase the gain A inside the box as much as we like without affecting the overall gain, which stays very close to $R_N/R_g = 1/B$. (The gain due to the input transformer is neglected at the moment). We are therefore free to alter $R_4$, which alters the output impedance, without altering the overall level unless, of course, we make the circuit unstable. If we fix a minimum value of $R_4$ at about 20 times $R_1$ we can persuade the output impedance to go just negative, and by increasing $R_4$ we can produce a range of output impedances up to a maximum of $[r_a/(1 + AB)]/n$ where $r_a$ is the anode impedance of the valve and $n$ is the output transformer ratio.

At this point I feel a certain diffidence. My landlord occupies the flat above me, and the temptation to build one of those nice 100-watt audio amplifiers has always been sternly repressed. In fact, as I write the loudspeaker is operating at a pleasant 50 mW. My work on this variable-impedance amplifier has been based on a 1-watt output level, using a single-sided amplifier. The valves used were a 6J7 and a 6L6, because the foreign customer to whom the equipment is to be sold refuses to be committed to valves from one particular maker. He hasn't any dollars, but by using American types he can get a much wider choice of suppliers than if he has valves on the British Spring 1949 base which will go out of fashion sooner than did the New Look. With these valves, $R_2$ in Fig. 3 was 33 kΩ, $R_1$ 620Ω, $R_3$ 220Ω, and $R_4$ a 100-kΩ variable resistor. No trouble was experienced due to small bias changes caused by the d.c. which flows through $R_4$. With this circuit an output impedance of less than one-tenth of the load impedance was easily obtained.

There is another use for this circuit. If you like having the same programme in all the rooms in your house, if you have a house and can't make one speaker heard all through it, this low impedance amplifier is very useful. By feeding a line from a very low-impedance amplifier, additional loudspeakers can be added without altering the level at those already connected. Obviously the amplifier must have sufficient power available to drive the maximum number of loudspeakers, but if this is so the amplifier adjusts itself to deliver constant voltage irrespective of the load.

Examination of the Williamson amplifier circuit (Aug. 1949 issue) suggests that it should be possible to apply positive feedback from $V_5$ to $V_3$ and from $V_6$ to $V_4$. This involves splitting $R_{16}$ into two 780-ohm resistors, and $R_{22}$ into two 300-ohm resistors. Equal amounts of feedback must be provided, but readers who have constructed this amplifier may find the experiment of interest.



General view of the DCR19 receiver showing layout of the front panel. The left-hand scale is for bandspread, the right-hand one carries the six main scales.

**TEST REPORT**

# Denco Model DCR19

## *Communications Receiver Embodying a Coil Turret and Crystal Calibrator*

ONE of the distinctive features of the Denco DCR19 communications receiver is the use of a rotary coil turret which removes all the idle coils from the circuit and short circuits any that might act as absorbers for those in use. The turret is particularly well made and all coils are wound on polystyrene formers and have air-spaced trimmers.

Embodied in the coil unit is a mechanical bandspread tuning system which enables a small part of any of the six wavebands to be expanded for ease of tuning, it also enables very accurate measurement of the received stations' frequency to be made. For this purpose a 500-kc/s crystal calibrating oscillator is used.

The six wavebands provided by this receiver have respective coverages of the following frequencies:—

175 to 525 kc/s
515 to 1,545 kc/s
1.65 to 5.0 Mc/s
4.8 to 9.6 Mc/s
9.4 to 18.8 Mc/s
18.0 to 36.0 Mc/s

The parts selected for bandspreading are the five amateur wavebands as follows:—

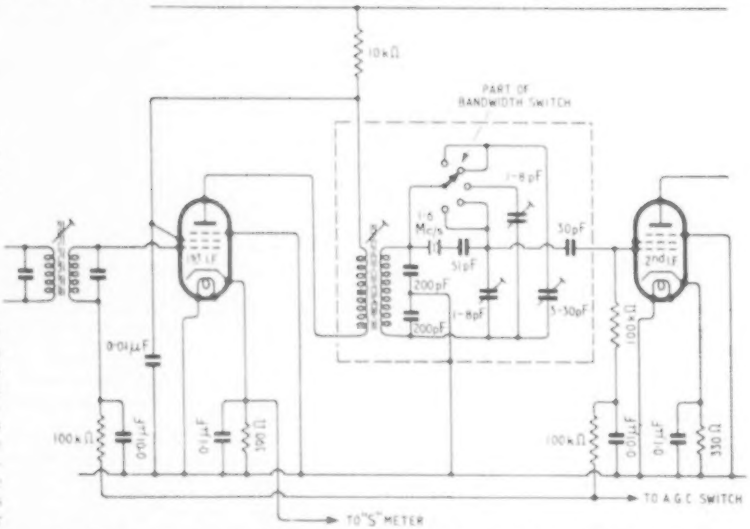
3.5 to 3.8 Mc/s
7.0 to 7.4 Mc/s
14.0 to 14.8 Mc/s
21.0 to 21.8 Mc/s
28.0 to 29.8 Mc/s

Inclusion of the 21-Mc/s band is in anticipation of its release as it is not yet allotted for amateur use in this country. These bandspread selections would indicate that the receiver is largely intended for the amateur market both here and overseas. The inclusion of a power outlet socket at the back of the set for operating a converter, presumably of the v.h.f. variety, also lends weight to this assumption. In any case, it is a useful feature as it gives access to a 6-volt a.c. supply and to the h.t. on-off switch connections so that a relay could be fitted externally to the set and operated from a remote point if needed.

An examination of the specification reveals that the unusually high intermediate frequency of 1.6 Mc/s is used. This choice undoubtedly assists image signal rejection and enables one r.f. stage to suffice for all bands. For this an EF91 valve is used, and in view of the high efficiency of the wave-change system and of the coils quite a high gain is given by this single stage.

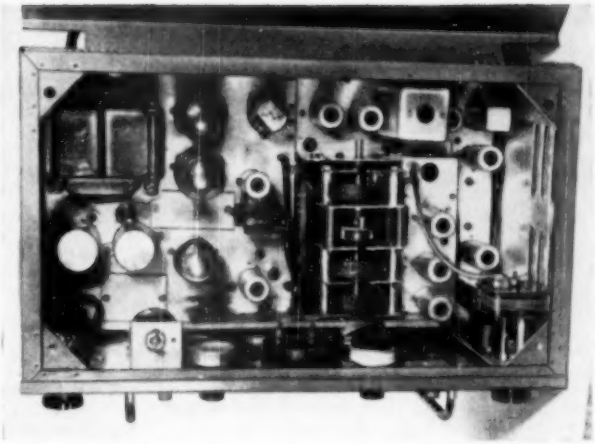
High intermediate frequencies have their disadvantages as well as advantages, but the only one of any consequence is the need to employ a few more tuned circuits in order to obtain adequate adjacent channel selectivity. In the DCR19 there are eight circuits distributed between three i.f. amplifying stages using 9D6 valves. Together they give a maximum bandwidth of 8 kc/s.

There are, all told, five different bandwidths available; the 8-kc/s one already mentioned, 8 kc/s plus




Circuit details of the inter-stage coupling following the first i.f. valve showing crystal filter and part of the bandwidth switching which includes also switches for the audio filter and i.f. gain.

This view of the inside of the receiver shows the gang capacitors, the crystal calibrator in the centre and the aerial matching capacitor on the right.



an audio filter, 1.5 kc/s, 0.5 kc/s and 0.5 kc/s plus an audio filter. A quartz crystal gate is used for the last three and the audio filter mentioned, which is used mainly for c.w. reception, has a mid-point frequency of 950 c/s and, with the crystal, gives an effective bandwidth of about 100 c/s.

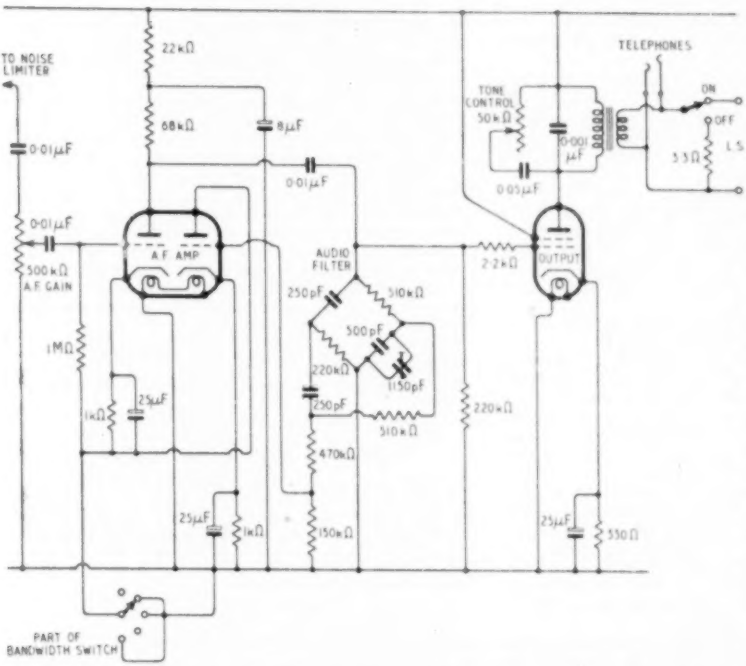
Although the frequency changer is an EHC35 triode-hexode valve it has a separate oscillator (EF91), but this combination is not uncommon in communications receivers.

It is followed by the three i.f. stages already mentioned, then by an EB91 double diode combining the functions of second detector and a.g.c. with another EB91 for the noise limiter. There is also a beat oscillator (EF91) for c.w. reception, the 500-kc/s crystal calibrator (EF91), a penultimate a.f. amplifier, and finally a pentode output stage giving about 4 watts of audio for an external 3-ohm loudspeaker. Provision is made for headphones.

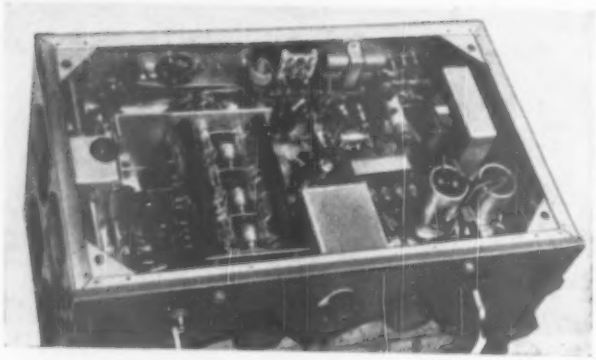
The crystal calibrator is not exclusively a refinement, but it plays a large part in the bandspread system. Without it there would be some uncertainty in setting the main tuning dial to the exact beginning of the bandspread portion. With it all uncertainty is removed and the frequency calibrations of the bandspread dial then have a real meaning.

Opinions may differ regarding the value of an "S" meter, but no communications set appears to be without one. They can be of considerable help if the receiver's gain is kept reasonably constant, not only over the individual ranges but over the waveband as a whole. In the DCR19 a serious effort has been made to achieve this by adjusting the gain of the i.f. amplifiers when switching from one bandwidth to another and in the r.f. amplifier by suitable design of the interstage couplings.

From the frequency changer to the second detector the gain of the set is controlled normally by a.g.c. voltages




Incorporated in the first audio amplifier is a negative feedback circuit which behaves as an audio filter. The negative feedback becomes operative only when the bandwidth switch brings the audio filter into use. A dummy load is incorporated for use with telephones.



Removing the bottom plate of the cabinet reveals the coil turret, boxed-in b.f.o. (in centre) and gives access to all the under-deck wiring.

developed by the signal. The r.f. stage is not controlled in this way, but there is a manual gain control having a limited effect, as this valve is not one of the variable-mu kind. This control must be set to maximum gain position for the "S" meter readings to have any meaning.

Manual control of the i.f. gain is provided as an alternative to, but not in conjunction with, a.g.c., and this is effected by applying a variable negative bias, derived from a resistor joined between h.t. negative and chassis, to the first two i.f. stages. A potentiometer is connected across this resistor. All stages have cathode resistors for providing minimum bias.

The receiver is a.c. mains operated and incorporates a power transformer, valve rectifier and all smoothing circuits, a VR150/30 voltage stabilizer giving a perfectly steady d.c. voltage for the local oscillator, mixer screen, beat oscillator and for "bucking" the "S" meter.

Though not difficult to operate, this Denco set calls for a few hours of handling fully to appreciate its merits. Sensitivity is high, which is not surprising with three i.f. amplifiers, and it is well maintained throughout the entire waveband. Exceptionally good results were obtained on the highest frequency range in daylight.

the lack of a bandwidth intermediate between 1.5 and 8 kc/s was occasionally felt as the first is rather narrow for telephony while the second is rather broad for some parts of the short-wave ranges, when a 3.5 kc/s bandwidth is generally the most useful. This does not mean to say that speech is by any means unintelligible with a 1.5 kc/s bandwidth ; it is not, but the receiver must be very accurately tuned, and this is where the "S" meter comes in very useful. Slight mistuning under these conditions can produce quite noticeable distortion and, with very strong signals, to overloading of the i.f. stages which normally depend solely upon a.g.c. to control the gain. Of course, it is always possible to turn to manual control, but the a.g.c. behaves so well on telephony (and m.c.w.) and c.w. telegraphy that one is reluctant to dispense with its aid.

For c.w. reception the time constant of the a.g.c. system can be lengthened considerably by switching to the "c.w." position, and under these conditions there is no rise in sensitivity (and in background) during the brief intervals between morse characters.

When the proper procedure is followed the band-spread calibration becomes surprisingly accurate. On the 80-metre amateur (3.5 Mc/s) band it is easily possible to read a station's frequency to within 2 kc/s on the dial, and as the calibration of each of these ranges is checked initially against the 500-kc/s crystal oscillator, a very high order of accuracy is possible. On the 10-metre (28 Mc/s) band the reading accuracy is to within about 5 kc/s.

Checks of the calibration made throughout the waveband, and using the 500-kc/s oscillator, showed that the frequencies marked on the scale are, in the main, to be relied on. In a few cases small discrepancies were noticed but in the majority of cases they amounted to little more than the thickness of the line on the cursor.

Six coloured spots are marked on the cursor for range identification, and they tally with like coloured spots on the waveband change knob which operates the coil turret.

No other indication of range, or position, appears on the turret control so that in a poor light, or if the operator is a little uncertain of his colours (the blue and the green were not very distinct on our receiver), confusion might arise. Figures or letters to supplement the coloured spots would be desirable.

To sum up, the DCR19 possesses about as much sensitivity as can be used in any ordinary location. Some experience is necessary before the best can be extracted from it, but this qualification is not exclusive to radio sets. In the main, the set gives an extremely good account of itself and performs the functions one expects of a communications receiver. Some emphasis has been laid on the qualities for amateur use, and in view of its general form and price it should have a wide appeal in this sphere.

The receiver is housed in a well-ventilated metal cabinet with a hinged lid that folds right back and the finish is grey enamel.

The overall size of the set is $16\frac{1}{2} \times 10\frac{1}{2} \times 11\frac{1}{2}$in, the weight 30 lb and the price £49. The makers are Denco (Clacton), Ltd., Old Road, Clacton-on-Sea, Essex.

## Sealed Valve Containers

A NEW method of packing electronic valves for dispatch overseas has been introduced by the General Electric Company. Cylindrical flanged containers are formed by impact extrusion from an aluminium slug and fitted with lids which are hermetically sealed by the cold pressure welding process recently evolved by the G.E.C. Research Laboratories.

## "K.F." Record Changer

We are asked to state that the "K.F." automatic record changer described on page 34 of the January issue is made by Kingsbury Fitch and Company, Sidcup, Kent. Brooks and Bohm are one of the main distributors of this product.

# These Valves make News!

## RELEASE OF B9A (Noval) Types

A complete new range of double triodes especially designed for television and industrial applications. Each type features separate cathode connections and centre tapped heaters for operation on AC or AC DC supplies.

Bulb diameter $\frac{7}{8}$in. max.
Seated height, $1\frac{13}{16}$in. max.

### TYPE 12AT7

| | | |
|---|---|---|
| Heater Voltage | 6.3 or | 12.6 volts. |
| Heater Current | 0.3 | 0.15 amp. |
| Anode Voltage | 300 volts max. | |
| Anode Dissipation | 2.5 watts max. per section. | |
| Mutual Conductance | 6.6 mA/Volt. | |
| Amp. Factor | 62 | |

Application :—As Oscillator up to 600 Mc/s. Frequency changer up to 450 Mc/s.

### TYPE 12AU7

| | | |
|---|---|---|
| Heater Voltage | 6.3 or | 12.6 volts. |
| Heater Current | 0.3 | 0.15 amp. |
| Anode Voltage | 300 volts max. | |
| Anode Dissipation | 2.75 watts max. per section. | |
| Cathode Current | 20 mA. max. per section. | |
| Mutual Conductance | 3.1 mA/V. | |
| Amp. Factor | 19 | |

Application :—Oscillator, phase inverter and A.F. amplifier.

Bulb diameter, $\frac{7}{8}$in. max.
Seated height, $1\frac{13}{16}$in. max.

Bulb diameter, $\frac{7}{8}$in. max.
Seated height, $1\frac{13}{16}$in. max.

### TYPE 12AX7

| | | |
|---|---|---|
| Heater Voltage | 6.3 | 12.6 volts. |
| Heater Current | 0.3 | 0.15 amp. |
| Anode Voltage | 300 volts max. | |
| Anode Dissipation | 1.0 watt max. per section. | |
| Mutual Conductance | 1.6 mA/V. | |
| Amp. Factor | 100 | |

Application :—A.F. Amplifier and phase inverter in high gain circuits.

**BRIMAR**

WRITE NOW TO DEPT. 4530 for data sheets on the above valves.

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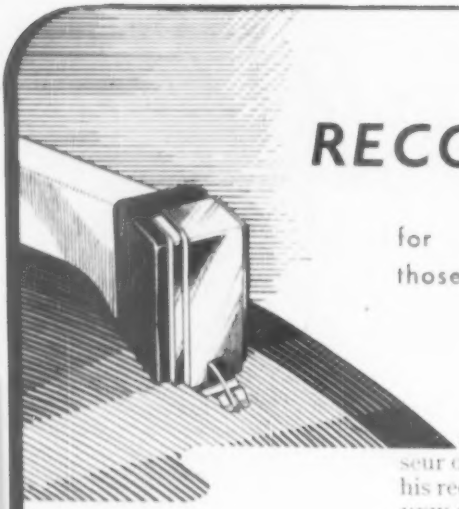

# RECORD NEWS...

for MUSIC LOVERS & those seeking faithful reproduction

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Output ½v. at 1,000 c.p.s. —5 to 20 times greater than comparable magnetic types.

◇

**Automatic bass-boost** —can be fitted to any domestic radio without additional equalisers.

◇

Needle talk and motor rumble negligible.

◇

Low needle pressure—14 grms. — virtually eliminates record wear.

◇

Unbreakable and non-hygroscopic crystal element.

◇

Permanent sapphire stylus eliminates needle change.

acos

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# Ionosphere Review: 1949

## *Sunspot Cycle and Short-wave Propagation Survey, with Forecast for 1950*

By T. W. BENNINGTON (*Engineering Division, B.B.C.*)

ALL doubts as to the time of occurrence of maximum activity in the present sunspot cycle were set at rest with the publication from Zurich, about the middle of 1949, of the final sunspot numbers for 1948. These showed that during no month of 1948 did the mean level of the sunspot number reach so high a value as that which was recorded for May, 1947, and, furthermore, that the twelve-month average value for the sunspot number was also at its peak about that time, namely, at the epoch May/June, 1947. We may therefore assume that that was the epoch of maximum activity in the present cycle.

Since the maximum some rather peculiar variations in sunspot activity have taken place; peculiar, however, only when viewed in relation to the relatively smooth variations which occurred during several years prior to 1947. In short, sunspot activity has not, since the maximum, decreased in anything like a smooth manner, but has undergone some large and erratic up-and-down variations. The activity during 1949 was, on the average, only very slightly lower than that during 1948, a fact which may seem somewhat surprising with the maximum so long past. However, smooth variations—even in the twelve-month running average values—cannot legitimately be expected with confidence, for, if the sunspot cycles of the past 200 years are examined, it is seen that similar up-and-down variations to those which are now taking place are really quite a common occurrence.

*Wireless World* has, at the end of the past several years, published a review of sunspot and ionospheric conditions, in order to indicate how the conditions for short-wave propagation have varied, and how they may vary in the immediate future. The present review, therefore, will deal with these points as revealed by past measurements of sunspot activity and of ionospheric critical frequency, with particular reference to the changes which occurred during 1949, and to those which may occur during 1950.

**Course of the Sunspot Cycle.**—In order to show the general course of the present sunspot cycle and the degree of sunspot activity prevailing at present the curve of Fig. 1 is given. In this are plotted the mean annual values of the sunspot relative numbers for a period covering the whole of the last and present sunspot cycles. The maximum in the present cycle is seen to have been considerably higher than that in the last—which was itself a relatively high one—and was, in fact, one of the highest maxima on record since 1749, when continuous records of the sunspot numbers first began. Since 1947—the year of maximum activity—the sunspot activity has decreased only slightly and, during 1949, was very little lower than during the preceding year. Thus the smooth cyclic variations of the preceding years were somewhat upset during 1949. The main point to note is that the decrease since the maximum has been very slow, so that at the end of 1949 we find ourselves experiencing considerably higher sunspot activity than would have been expected on the basis of the past years' relatively smooth variations.

It will be noted also that, since the sunspot activity is still considerably higher at the end of 1949 than it was at the last sunspot maximum, quasi-maximum conditions still prevail. As will be later shown, ionospheric and short-wave conditions since the maximum have followed the sunspot activity very closely, so that the above remark applies to these as well as to the sunspot numbers. The ionospheric critical frequencies in northern latitudes were, in fact, somewhat higher in the autumn of 1949 than in that of 1948 and only slightly lower than those for the maximum year of 1947. The frequencies usable for short-wave communication are still very high.

**Ionospheric Variations.**—The top (full line) curve in Fig. 2 gives the monthly mean values of the sunspot relative numbers for each month during the present sunspot cycle, while the two bottom (dashed) curves give the monthly means of the $F_2$-layer critical frequencies for noon and midnight respectively. The latter data are those obtained at the Slough station of the D.S.I.R.

Despite erratic month-by-month variations sunspot activity showed a generally increasing tendency from the minimum of 1944 to the maximum in May, 1947. Since that time the variations have often been of greater amplitude, and after decreasing considerably for several months the sunspot number has then several times returned to a value almost as great as that of the maximum. So far as 1949 is concerned it cannot be said that any decided tendency to decrease has become apparent.

The critical frequency curves, which have large seasonal variations in them, both show a gradual

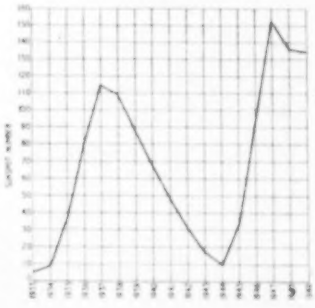


Fig. 1. Mean annual values of sunspot relative numbers.

upward sweep towards the maximum, but since then only a slight tendency to decrease. As has been said the noon value for November, 1949, was greater than that for the same month of the previous year, indicating that higher daytime working frequencies could have been used for short-wave communication. Short-wave working frequencies during this, the third winter season after the maximum, were still of the very high order generally associated with the sunspot maximum itself.

The seasonal variations in the critical frequency curves are very interesting in themselves. So far as the noon values are concerned it is seen that the lowest occur in summer and the highest towards the winter, and that there is a far greater difference between summer and winter values when the sunspot activity is high than when it is low. This means that the magnitude of the critical frequency increase due to the effects of the solar cycle is far greater in winter than in summer.

It is very interesting to note the small subsidiary decrease in critical frequency which occurs in the noon curves at the extreme mid-winter period, resulting in the peak seasonal values occurring at about November and February. It will be observed that this decrease has occurred during every winter of the present cycle, though during the 1947/48 winter alone there was no subsequent recovery after the decrease, resulting in the curve for that winter being a single-peaked one, whereas all the others are double-peaked. It will be noted that during January and February, 1948, there was a sharp decrease in the sunspot number, and there can be little doubt that this lowered solar activity, which occurred at a time when the critical frequency usually increases, was the responsible factor.

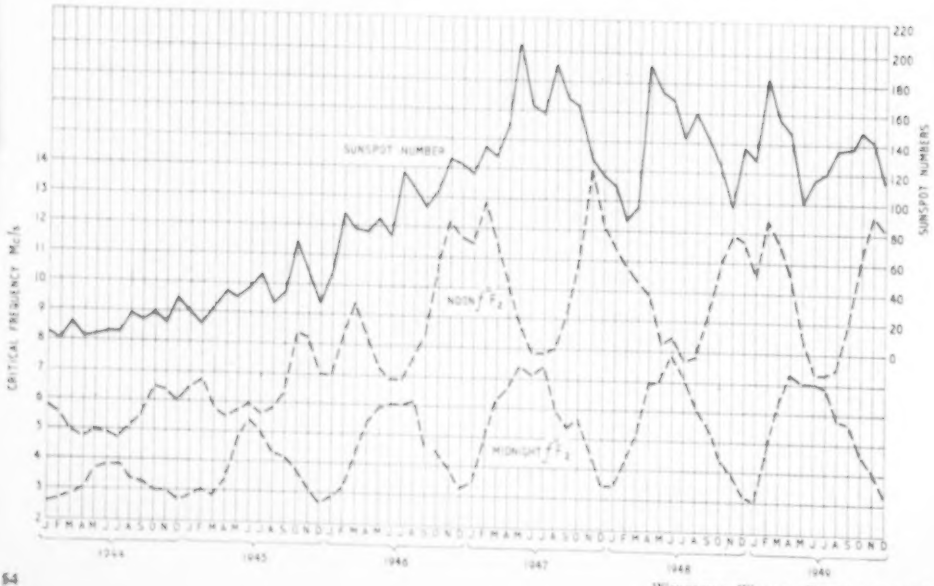
Such an occurrence as this well illustrates the difficulties with which forecasters of ionospheric conditions have to contend when making predictions for short-wave propagation some months ahead.

The midnight critical frequency curves show (as is always the case) seasonal variations of a character opposite to those for noon, the highest values occurring in mid-summer and the lowest in mid-winter. It is due to the earlier onset of darkness in winter than in summer, during which ionization by the sun ceases and only recombination takes place.

**Correlation between Sunspot and Ionospheric Measurements.**—In Fig. 3 are given (full line curve) the twelve-month running average values of the sunspot number during the present cycle, and (dashed line curves) the twelve-month running averages of the noon and midnight $F_2$-layer critical frequencies over the same period, taken from the measurements made at Slough. By taking twelve-month running averages of these quantities the month-by-month variations in the sunspot number and the seasonal variations in the critical frequencies are smoothed out, so that the long-period effects in both quantities are made more apparent. The twelve-month average for the epoch at the centre of any month is the average of the twelve monthly means having that month as the centre.

These curves show that both noon and midnight critical frequencies responded to the changing sunspot activity very faithfully, though towards the maximum the sunspot number appeared to increase more rapidly than the critical frequency. Generally speaking, the correlation between the curves—sunspot and critical frequency—is very good, and it may be mentioned that the same good agreement between the sunspot curve and those for critical fre-

Fig. 2. Relationship between solar activity changes and propagation conditions: monthly mean values of sunspot numbers and of noon and midnight F-layer critical frequencies during the present sunspot cycle.



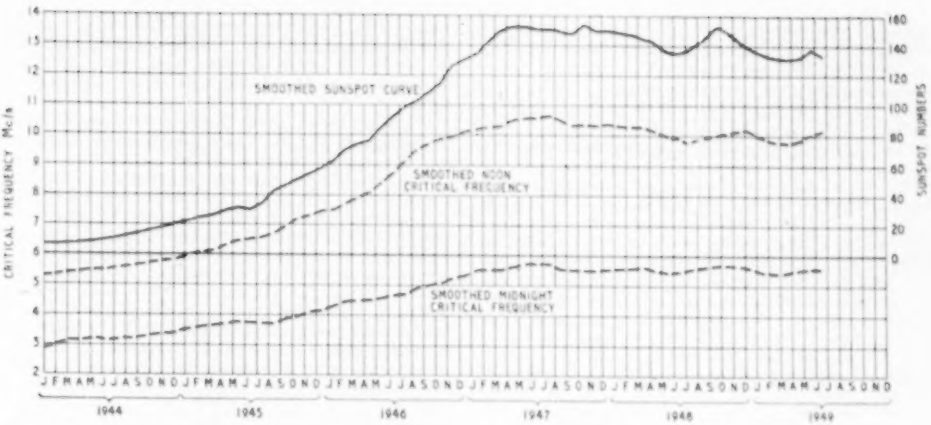



Fig. 3. Twelve-month running averages of sunspot numbers and of noon and midnight F-layer critical frequencies.

quency can be had for other times of day, and for other ionospheric layers, though the magnitude of the variation is different for different times of day, and for different layers. All this shows that the critical frequencies, and thus the m.u.fs, for short-wave communication, are, at least to a first approximation, directly proportional to the sunpot number.

Having noted that the maximum in the sunspot curve occurred at the epoch May/June, 1947, we become particularly interested in what has happened to both curves since that time, and more particularly during the last 12 months. It will be noted that in a twelve-month running average curve it is only possible to plot up to an epoch six months back from the date of the latest data available. The smoothed sunspot curve—indicating the general degree of solar activity—is seen to have undergone but a slight measure of decline since the maximum, and there has been one very considerable increase to nearly maxima values. Each trough and peak in the sunspot curve is seen to be reflected in those for the noon and midnight critical frequencies, though the latter show these effects somewhat later. For example, the maximum in both critical frequency curves appears to have occurred one month later than that in the sunspot curve, while the trough of May/June, 1948, and the peak of September/October, 1948, are followed by similar troughs and peaks in both critical frequency curves about two months later. All this, when one considers the rather arbitrary nature of the sunspot number, is rather remarkable.

The year 1949 can be regarded as one of particularly good short-wave conditions, for the following reasons. When the ionization of the $F_2$ layer is exceptionally high, as it was during 1949, the high limiting frequency for short-wave communication is at its greatest value. Under the same conditions of high sunspot activity the ionization of the D-layer—the principal absorbing region—is also raised, but only to a moderate extent as compared with that of the $F_2$-layer. The absorption determines the low limiting frequency, and as this is not unduly increased, it means that the band of useful frequencies is exceptionally wide. Such wide band conditions will not prevail when sunspot activity becomes appreciably lower and the restriction of useful band width will become particularly acute at night.

**Practical Results.**—That the highest frequencies actually propagated during 1949 were of the same order as during 1948 is confirmed by the records of reception conditions in this country during 1949. The critical frequency curves of Fig. 2 imply that, in the ionosphere immediately above Slough the mean m.u.f. for February was of the order of 41 Mc/s, that in June it had fallen to about 24 Mc/s, and in November had risen again to the order of 42 Mc/s, a value slightly greater than that of November, 1948. Of course, the m.u.f. is much modified by conditions over the whole transmission path, which generally tend to reduce it from the value prevailing at either end, on the other hand it frequently is higher than the mean value for a particular month. Nevertheless, these figures give some idea of the order of things to be expected.

The records show that during January, February and March, American police and other signals were frequently received in this country on frequencies of 36 to 42 Mc/s, whilst the London television service on 45 and 41.5 Mc/s was received in South Africa on many occasions. In March there were also one or two reports of amateur reception on 50 Mc/s in this country from South Africa. In late April the amateur frequency of 28 Mc/s began to show signs of failing in certain directions, in May this effect became accentuated, whilst in June and July it was very seldom usable. In April the London television station was received in South Africa frequently, in May on a few occasions only, and in June and July not at all. By September 28 Mc/s was becoming much more frequently usable in many directions from this country, while by October it was in regular use over most circuits. During September television was received in South Africa on seven days, whilst in October such reception again became frequent. In November and December American police and f.m. signals on frequencies up to 43 Mc/s were again received here frequently, and television was almost regularly received in South Africa.

These results exemplify the high order of fre-

quencies the ionosphere is at present capable of propagating, and closely agree with those indicated by the ionospheric measurements.

**Forecast for 1950.**—It is impossible to say, from a study of the top curve of Fig. 3 how the sunspot activity may vary during 1949. As is seen, the activity of late has shown no very definite trend. All things considered, however, it is likely to decrease and even to do so at a somewhat greater rate than has been apparent since the maximum. If the cycle is compared with the more recent of the past ones this would appear to be the most likely thing to happen, and from this comparison we should estimate that the running average sunspot number for the epoch at the middle of 1950 might be about 106. If this were so it is probable that the running average noon critical frequency will fall to about 9.5 Mc/s, and that for midnight to about 4.8 Mc/s.

We cannot here venture to predict what the m.u.fs. for each month of 1950 are likely to be, but if the sunspot variation is of the order indicated above the m.u.f. for longest distance working in these latitudes should, by November, 1950, have fallen to about 36 Mc/s, as compared with 42 Mc/s in November, 1949. The "optimum working frequency" should then be about 30.6 Mc/s. The detailed specification of u.w.fs. for every direction from this country is, of course, very complicated, and cannot be attempted here.

Predictions for certain circuits will be given month by month in "Short Wave Conditions." So far as the frequencies now generally in use for long-distance communication are concerned it does not appear likely that any great changes will take place in 1950, for not until sunspot activity has decreased considerably do the ionospheric changes begin to make themselves felt and the regularly used frequency bands become unworkable. It is unlikely, however, that the amateur 50-Mc/s band will be workable for long-distance communication at any time during the year, or that the 28-Mc/s band will be usable from about April to October.

Summing up the prospects for 1950, we may use exactly the same words as concluded this review last year, by stating that during 1950 "good radio conditions should in general prevail, and conditions tend to favour the high, but not the exceptionally high, short-wave frequencies."

# SHORT-WAVE CONDITIONS

## *December in Retrospect: Forecast for February*

THE average maximum usable frequencies for these latitudes decreased both by day and night during December, which was in accordance with the usual mid-winter trend. Day-time working frequencies were, however, still relatively high, and American police and other transmissions on about 40 Mc/s were often received in this country during the first half of the month. Reception of the London television service in South Africa was not so frequent as during November. The 28-Mc/s band was usable on undisturbed days at the appropriate times over most circuits. Night-time working frequencies above 7 Mc/s were not *regularly* usable.

Sunspot activity was, on the average, considerably lower than during November, and lower, in fact, than in any month since June.

December was an exceptionally quiet month and no severe ionospheric storms occurred. Storms of minor intensity took place on 4th, 7th-8th, 10th-12th, 17th-19th. A severe Dellinger fade-out occurred at 1256 on 12th, but only one other, of minor intensity, was reported during the month.

Long-range tropospheric propagation apparently occurred on several occasions during the month, and was particularly noticeable on the evening of 7th.

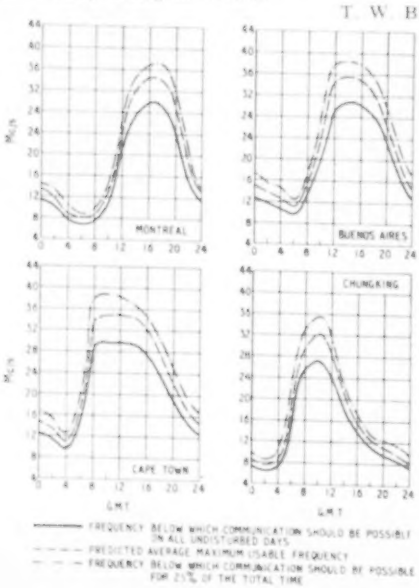
**Forecast.**—During February day-time m.u.fs. in these latitudes should be considerably higher than during the past two months, whilst night-time m.u.fs. should also increase.

Long-distance working frequencies should therefore be exceptionally high by day, and frequencies as high as 28 Mc/s should be *regularly* usable over most circuits at the appropriate time of day, whilst those up to about 40 Mc/s may become workable on occasional days during the month. At night, frequencies of the order of 7 or 8 Mc/s are likely to be the highest *regularly* usable over most circuits.

As a rule ionospheric storms are not particularly frequent during February, but those which do occur are often very troublesome during the dark hours.

The curves indicate the highest frequencies likely to be usable over four long-distance circuits from this country during the month.

T. W. B.



# WORLD OF WIRELESS

## New International Organization? Television Standards for Europe • "H" Aerial Controversy • Servicemen's Wages

### *European Broadcasting*

WHEN the Copenhagen Convention and wavelength plan for European stations was drawn up it included the provision that "an international expert organization" should be appointed to supervise the introduction of the Plan—due on March 15th.

It will be recalled that for the past two years or more there have been two European broadcasting organizations — the International Broadcasting Union (U.I.R.), which has been operating for many years, and the International Broadcasting Organization (O.I.R.), which was formed in 1946.

Great Britain is not a member of either organization, having withdrawn its support from the U.I.R. some years ago. It is perhaps understandable therefore that the B.B.C. has been asked to convene a conference of the broadcasting organizations of countries in the European zone which are members of the International Telecommunication Union. The object of the conference, which is arranged to open on February 6th, is to form a new European broadcasting organization. As the president of the U.I.R. was present at the meeting in Paris, at which this decision was taken, it is presumed that the U.I.R. will be superseded by the new organization.

This decision follows quickly upon the announcement that eleven member countries have withdrawn their support of the O.I.R. on the grounds of the domination of the Eastern European bloc.

### *International Television*

WITH a view to the cultural unification of television in Great Britain, France, Belgium, the Netherlands and Luxembourg, representatives of each of the countries met in London on January 10th.

It will be recalled that at a recent meeting in Zurich, representatives of France agreed to change her present 455-line transmissions to conform with the British 405-line standard. France further stated that she would continue to develop her 819-line system. It was announced by the British representatives that when a change was made in this country to a higher definition it would be to 800 lines or more.

The Netherlands has rejected both standards in preference for 625 lines which, when the difference in mains periodicity is taken into account, is comparable with the American 525-line system.

The outcome of the meeting is awaited with interest.

### *Television Aerials*

CONSIDERABLE interest centres around the television aerial—especially the "H" variety—at the present time. Whilst it cannot be claimed that these aspirate excrescences are things of beauty, they are essential in areas of low field strength. It is only in places where the signal is strong that a loft aerial is adequate. It is therefore with some misgivings that we read of the decisions of a number of borough and district councils prohibiting their use.

There have been a tremendous number of references to this matter in the lay Press, especially since the opening of the Midland station. Whilst some councils have banned the erection of television aerials on their property, others require a deposit of as much as £5 from tenants before they are allowed to erect an aerial—part of this is returnable when the installation has been approved by the borough surveyor.

In one housing estate, only indoor aerials are permitted, except in the case of bungalows where a single dipole is allowed. Many boroughs have stipulated that aerials must be fitted by an approved dealer.

### *Midland Exhibition*

THE Radio Industry Council is planning to hold an exhibition at Castle Bromwich, Birmingham, in September, with television as the main feature. As already announced there will not be a national radio exhibition at Olympia this year.

### *Service Technicians' Wages*

A NEW scale of wages for certified service technicians has been announced by the Joint Standing Committee for the Radio Service Trade. Technicians on the Register of the Joint Standing Committee (previously known as the Radio Service Trade Register), will now receive the following minimum weekly rates according to the class of certificate held (the previous rate was in each case 7s 6d less):—

Holders of certificate "A," which is issued to persons admitted to the register by virtue of their having passed the R.T.E.B. examination, £6 12s 6d per week.

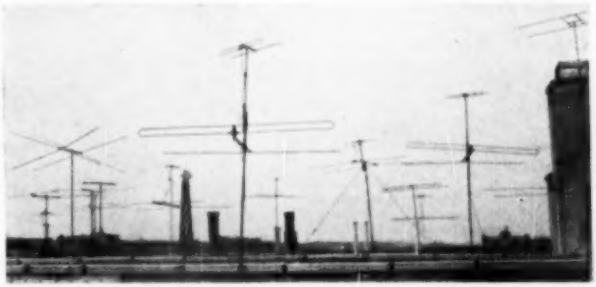
Holders of certificate "B," which is issued to radio service technicians admitted to the register on the basis of having served an approved apprenticeship or having had five years' experience in an approved employment, £6 7s 6d per week.

Holders of the television certificate, which is issued to holders of "A" or "B" who have also satisfactorily finished the television course of a manufacturer, £6 17s 6d a week.

The minimum wage for servicemen over 21 who are not on the Register is £5 5s.

### *Servicing Certificate Exam*

THE Radio Trades Examination Board announces that the closing date for entries for the next Radio Servicing Certificate examin-



**NEW YORK SKY-LINE.** This photograph of the variety of television and f.m. aerials on a block of flats in New York is pertinent in view of the television aerial controversy in this country. There are, of course, 7 television stations in New York, all working on different frequencies.

ation, which is held jointly by the R.T.E.B. and the City and Guilds, is February 1st.

The written examination will be held on May 2nd and 4th at centres throughout the country, and the practical examination on May 20th at only five centres—London, Birmingham, Manchester, Glasgow and Bristol.

Further details are obtainable from the R.T.E.B., 9, Bedford Square, London, W.C.1.

## *B.B.C. Governors*

THE KING has approved the appointment of three new Governors of the B.B.C. in place of Sir Richard Peck, Miss Barbara Ward and Geoffrey Lloyd, who retired at the end of the year. The new Governors, who will serve for two years, are Lord Tedder, Lord Clydesmuir and Prof. Barbara Wooton.

The seven members of the Board of Governors control the policy of the B.B.C. and it is to them that the Director-General—Sir William Haley—is directly responsible for the efficient working of the Corporation. The chairman of the Governors is Lord Simon and the other members, the Marchioness of Reading, Dr. Ernest Whitfield and John Adamson.

## *Standard Frequencies*

AN experimental standard frequency transmitting station is being operated by the U.S. National Bureau of Standards on the Island of Maui, Hawaii. This station, which uses the call WWVH and operates on 5, 10 and 15 Mc/s with a power of 3 kW, is being used in addition to WWV, Washington.

The station has been installed to investigate problems relating to the simultaneous operation of more than one transmitter on the frequencies allocated at Atlantic City for standard frequency broadcasts. Details of the station were given in the September issue of our New York contemporary, *Communications*.

## HONOURS

**John V. Foll,** managing director of Muirhead & Co. has been made an Officer of the Order of the British Empire (O.B.E.).

Among the recipients of the M.B.E. are:

**Thomas M. Brennan,** who is a radio officer of Flight Refuelling, Ltd., for services in the Berlin Airlift;

**Henry G. M. Castell** who is attached to the Diplomatic Wireless Service in the Foreign Office;

**Ernest Hoyle,** chief draughtsman at the Ministry of Supply's Telecommunications Research Establishment, Malvern;

**Kenneth B. Ling,** superintendent of Standard Telephones and Cables' factory at Treforest, Glamorganshire;

**James B. Stevenson,** a director of E.M.I. Factories, Ltd.; and

**Geoffrey W. Warren,** a physicist in the G.E.C. Research Laboratories, Wembley.

The British Empire Medal has been awarded to **James D. Sweetnam** who is assembly superintendent at E. K. Cole's Malmesbury, Wilts, factory.

## PERSONALITIES

**Air Cmdre. L. Dalton-Morris,** C.B.E., has been appointed chief signals officer at the Middle East R.A.F. Headquarters at Ismalia, Egypt. For two years he has been commandant of the R.A.F. Central Signals Establishment at Watton, Norfolk, prior to which he was Director of Signals at the Air Ministry. During the war he was associated with the development of radio and radar counter-measures.

**Dr. Harry F. Olson,** director of the R.C.A. Acoustical Research Laboratory, Princeton, N.J., has been awarded the first John H. Potts Memorial Medal by the Audio Engineering Society of America "for outstanding accomplishments in the field of audio engineering." The medal is named after the late Editor of our New York contemporary, *Audio Engineering*.

**A. John Gale,** who was appointed television manager of the Scophony-Baird factory at Wembley a year ago, has gone to the United States to investigate the marketing of Baird television receivers in North America.

**A. C. Gale** has been appointed manager of the Liverpool district office of the Edison Swan Electric Company.

**J. S. Mitchell,** who for many years was commercial manager at Cossor's, has joined Sobell Industries in an executive capacity.

**R. Petch** has been appointed by E. K. Cole as Outside Television Service Engineer covering the London area.

**C. Clark Ramsay,** who has been Press Relations Officer with E. K. Cole for four years, is returning to the publishing world. He is rejoining George Newnes, Ltd.

M. J. PULLING, M.A., who was recently appointed B.B.C. Senior Superintendent Engineer (Television), is vice-president of the British Sound Recording Association.

## IN BRIEF

**Receiving Licences.**—Although there were 17,350 fewer broadcast receiving licences in force at the end of November than a month earlier, 18,350 new television licences were issued during the month. The total number of licences at the end of November was 13,106,900, including 206,700 for television. A notice bearing the words "Warning! Is Your Wireless Set Licensed?" is being posted in all Post Offices reminding owners of broadcast and television sets of the necessity of obtaining a licence.

**Radio Control.**—The First International Radio-Controlled Model Boats Contest to be held in this country, has been arranged for Easter Sunday and Monday, April 9th and 10th. Details of the contest, which will be held at Fleetwood, Lancs, are obtainable from J. Heathcote, General Secretary, Radio-Controlled Models Society, 8 Henniker Street, Swinton, nr. Manchester. The society is exhibiting at the second Northern Models Exhibition which is being held in Manchester from March 24th to 26th.

**Standard Solder.**—A revision of the war emergency edition of the British Standard BS219, which restricted the number of grades of solder to five, has now been issued. It includes the composition of five antimonial and five non-antimonial solders. Appendices give the melting characteristics and typical uses of the solders listed and information on solders intended for use at temperatures higher than those for which normal alloys covered by the Standard are suitable. BS219:1949 is obtainable from the British Standards Institution, 24 Victoria Street, London, S.W.1, price 2s post free.

**Ship-to-Shore Stations.**—The British Post Office short-range ship-to-shore coastal radio stations at Malin Head, Donegal, and Valentia, Co. Kerry, which since the establishment of the Irish Free State have been operated by the Irish Post Office on behalf of the British Post Office, have now been transferred to the Irish Government.

**S.B.A.—Television Interference.**—Owing to the interference caused by the Alexandra Palace television transmitter with the reception of S.B.A. (Standard Beam Approach) in aircraft flying in the London area, one of the marker beacons (Type R1125D) has to be modified. The selectivity of the receiver has been found insufficient when a horizontal wire aerial, capacitively coupled to the grid circuit of the first valve, is used. Details of the modifications are given in the Ministry of Civil Aviation's circular 141/1949.

**G.R.S.E.**—At the fifth annual general meeting of the Guild of Radio Service Engineers, the following officers were elected:—president, M. Majury; chairman, T. F. Winning; vice-chairman, W. T. G. Wansden. The recently appointed assistant secretary is J. A. Monk and the registered office of the Guild is now 59 Madeira Road, Holland-on-Sea, Essex. (Tel.: Holland-on-Sea 3101.)

**Television Explained.**—Some 750 teen-agers attended the I.E.E. Christmas Lecture for Older School Children on "Television," delivered by H. L. Kirke, head of the B.B.C. Research Department, on January 3rd and 4th.

The lecture, which was illustrated by lantern slides, included mechanical and electronic demonstrations of the principle of scanning.

**French Scientific Instruments.**—A number of research organizations in France have combined to present in this country an exhibition of French scientific instruments—including some for radio research. The exhibition, during which a number of lectures will be given, is to be held at the Science Museum, South Kensington, London, S.W.7, from February 9th to 26th.

**New Transmitter.**—The B.B.C. has recently brought into service a new 2-kW transmitter in Bellahouston Park, Glasgow, to radiate the Third Programme. It replaces the 1-kW transmitter installed in Broadcasting House, Glasgow, as an emergency measure in 1940.

**C. & G. Report.**—The recently issued report of the Department of Technology of the City and Guilds of London Institute for 1948 shows that there was a net increase in the number of entries for the subjects grouped under "Telecommunication Engineering" of 2,208. Of the 20,962 examinees, 8,034 failed. Some 28 per cent of the 213 who sat for the Radio Service Work Examination failed to qualify.

**B.S.R.A. Exhibition.**—Plans are being made by the British Sound Recording Association to hold an exhibition of sound recording, reproducing and allied equipment for the weekend of May 20th and 21st, 1950, at the Waldorf Hotel, London, W.C.2. Lectures and demonstrations will be included in the programme.

**Imports.**—Among the range of goods from which import licensing restrictions were removed on January 5th are "parts of gramophones and radiogramophones." Certain countries, mainly those in the "dollar area" and Eastern Europe, are excluded from this relaxation.

**Channel Islands Telephony.**—The temporary single-channel radio-telephone link between Alderney and Guernsey has been replaced by a permanent six-channel link.

**Elementary Radio Classes,** including morse instruction, are being held on Wednesdays and Thursdays at 7.45 at the Deptford Men's Institute, Childeric Road School, New Cross, London, S.E.14.

**World Broadcasting.**—The 1949 edition of the "World-Radio Handbook for Listeners," published in English by O. Lund Johansen, Copenhagen, Denmark, is now available from Surridge Dawson and Co., 101 Southwark Street, London, S.E.1, price 6s 6d. It gives a wealth of information on the world's broadcasting stations and the organizations operating them.

**Amateur Radio.**—"The Transmitting Licence—or how to become a radio amateur," published by the Incorporated Radio Society of Great Britain, New Ruskin House, Little Russell Street, London, W.C.1, is now available in its third edition. Its purpose is well explained in the following opening passage taken from the introduction—". . . to present in a convenient form the essential information required by those who wish to obtain an Amateur Transmitting Licence." The price is 9d (1s by post).

**Philips** sound reproducing equipment being installed in Exeter Cathedral includes twelve microphones and 32 loudspeakers. The speakers will be incorporated in the lighting pendants.

**Industrial R.F. Heating.**—A special course of four lectures on "High-Frequency Heating in Industry" has been arranged by the Polytechnic, Regent Street, London, W.1. The lecturers are J. A. L. Wharton, R. E. Bazin, P. M. Paine, and E. S. Wilson, who are members of the research and design staff of Redifon, Ltd. Enrolment forms for the course, which will be given on Fridays at 6.30 commencing on February 24th, are obtainable from the Head of the Electrical Engineering Department. The fee for the course is 10s.

**Student Exchange.**—The second annual report of the International Association for the Exchange of Students for Technical Experience (I.A.E.S.T.E.), which was founded in 1948, shows that the number of students taking advantage of industrial experience overseas increased from 920 to 1,236. Great Britain sent 285 overseas and received 314. The next highest among the ten countries participating was Sweden. Ten radio manufacturers in this country received foreign students.

**Professional Engineers.**—Two additional branches of the Engineers' Guild—an association of professional electrical, mechanical and civil engineers—have recently been formed—the North-Western and the Southern.

**Courses in Radiotechnology** have been started at Allan Glen's School, Glasgow, as part of the Glasgow Corporation's Further Education Scheme.

**A Joint Conference** is being organized by the Institutions of Electrical, Mechanical and Civil Engineers to be held in London to coincide with the Festival of Britain, 1951. The proposed dates are June 4th to 15th.

**Television Costs.**—It was recently stated by the Postmaster-General that the annual rent of the London-to-Birmingham television link, whether the cable or the radio link was used, would be of the order of £50,000. This will, of course, have to be paid by the B.B.C. to the Post Office.

**Scientific Film Census** is being undertaken by the Scientific Film Association to bring up to date its records of documentary, instructional, educational and scientific films. Further particulars of the details required are obtainable from the association, 4, Great Russell Street, London, W.C.1.

**Servicemen** are not covered by the Government Order which specifies statutory wages for retail shop assistants. The Order (No. 2276/49), which came into force on January 23rd, includes, however, shop assistants in the radio and television retail trade.

**Apprenticeships.**—A brochure has been issued by the English Electric Co. outlining the apprenticeships available in the English Electric group of companies, which includes Marconi's and Marconi Instruments. It is available from the company's head office, Queen's House, Kingsway, London, W.C.2.

**Marconi** marine radio and radar gear has been installed in the New Zealand Shipping Co.'s latest vessel, *Rangitane*. The first *Rangitane*, which was sunk during the war, was equipped by Marconi's in 1929.

**Ideal Home Exhibition,** organized annually by the *Daily Mail*, will be held at Olympia, London, from March 7th to April 1st.

**E.M.I. Institutes** have acquired new premises at 10 Pembridge Square, London, W.2, for the college. (Tel., Bayswater 5131/2).

**Mullard Equipment, Ltd.,** is the new name given to the Mullard subsidiary which was previously known as Electronic Transmission Equipment, Ltd. The subsidiary was formed in 1947 for the development and manufacture of communications apparatus. The company's products are marketed by the Communications Division of Mullard Electronic Products, Ltd.

**Electronic Tubes, Ltd.**—It was announced at the annual general meeting of E.M.I. that all the ordinary shares in Electronic Tubes, Ltd., had been purchased by E.M.I. It will be recalled that Electronic Tubes, manufacturers of c.r.t.s and valves with a factory at High Wycombe, Bucks, were, until recently, a subsidiary of Cossor's.

**F. C. Robinson & Partners, Ltd.,** of Dalton House, Hargate Drive, Hale, Cheshire, have been appointed sole northern agents for Baldwin Instruments and Mullard Electronic Products.

## FROM ABROAD

**Switzerland.**—We have received a copy of the 18th annual report (1948) of the Swiss broadcasting organization. The sections dealing with each of the three main transmitters are printed in the language radiated—Sottens in French, Monte Ceneri in Italian, and Beromünster in German. The material regarding the general organization of Swiss broadcasting—both internal and international—is in French. The statistics show that 84 per cent of the families in Switzerland own broadcast receivers. The total number of licensed sets at the end of 1948 was 969,606.

**Anglo-American Exchange** of radio engineers is suggested by our New York contemporary, *Tele-Tech*. "The stimulus of an interchange of engineering thought in the field of radio and television should benefit both countries. For the British, U.S. methods of production would be an eye-opener . . . and some U.S. manufacturers could learn from the solid built-to-last construction of their British counterparts."

**A pictorial list** of the tuning signals of 77 American television stations is included in the January issue of our New York contemporary *Radio-Electronics*. It is interesting to see that about 50% are purely pictorial and are in no way intended as test patterns to facilitate receiver adjustment.

**Indian Licences.**—A 50 per cent increase in the broadcast receiving licence fees has been introduced in India. The new licence fee for domestic valve sets is Rs15 and that for sets in business premises Rs50. The fee for community receivers is Rs10 whilst a fee of Rs3 is payable by schools and institutions. The latter fee is also charged for crystal sets.

**Indian Peoples' Set.**—The design of a cheap medium-wave receiver for local reception is being undertaken by the

Research Division of All India Radio. The prototype two-valve a.c./d.c. set, which is expected to sell at between Rs25 and Rs30, has a cabinet said to cost only 4 annas. The valves used are the 6SJ7 and the 32L7GT.

**Colour Television Tests.**—It is understood from Washington that as a result of the recent investigation to formulate plans for the re-allocation of television frequencies in the U.S., the F.C.C. has called for public tests of colour television. Manufacturers of colour television equipment have been asked to transmit regular daily programmes for a specified period and to provide domestic receivers for the tests.

**819-line Television.**—The power of the French high-definition television transmitter, which has been in use experimentally since November 15th with a power of only 0.7kW, has now been increased to 5kW. The aerial is erected on the Eiffel Tower, Paris.

**International Television.**—The Swiss Television Committee has issued a statement following a recent meeting in which it is pointed out that 625 lines is becoming a world standard. The optimum bandwidth for this standard has yet to be agreed internationally. The two possibilities are 4.25 and 5Mc/s.

## NEW ADDRESSES

**British Relay Wireless, Ltd.**—The head office of B.R.W. and its associated companies, is now at Giltspur House, 6 Giltspur Street, London, E.C.1. (Tel.: City 3280.)

**E.M.I. Sales & Service** is opening a Mullard television service depot at City Chambers, 111-117 John Bright Street, Birmingham.

**Mullard** has opened a valve and cathode-ray service depot at 108, Dale End, Birmingham, 4. The service is restricted to callers.

**Telephone number** of the London office and showrooms of E. K. Cole at 5 Vigo Street, W.1., is now Regent 7090/9.

## MEETINGS

### Institution of Electrical Engineers

*Radio Section.*—"Ground-Wave Propagation Over an Inhomogeneous Smooth Earth," by G. Millington, M.A., B.Sc., and G. A. Isted, on February 15th.

*Informal Meeting.*—Discussion on "Interference Suppression," opened by E. M. Lee, B.Sc., on February 13th.

Both meetings will be held at 5.30 at the I.E.E., Savoy Place, London, W.C.2.

*Cambridge Radio Group.*—"Some Considerations in the Design of Negative-Feedback Amplifiers," by W. T. Duerdoth, B.Sc. (Eng.), at 8.15 on February 7th at the Cavendish Laboratory (Joint meeting with the Cambridge University Wireless Society).

*North-Eastern Radio Group.*—Discussion on "Control and Measuring Equipment; Electronic versus Non-electronic Apparatus" on February 6th.

"Theory and Design of Magnetic Amplifiers," by H. M. Gale, B.Sc. (Eng.) and P. D. Atkinson, M.A., on February 20th.

Both N.E. Radio Group meetings will be held at 6.15 at King's College, Newcastle-on-Tyne.

*North-Western Radio Group.*—"Printed Circuits, including Miniature Components and Sub-miniature Valves," by J. E. Rhys-Jones, M.B.E., and G. W. A. Dummer, M.B.E., at 6.30 on February 22nd, at the Engineers' Club, Albert Square, Manchester.

*South Midland Centre.*—"Television Radio Relay Links," by A. H. Mumford, O.B.E., B.Sc. (Eng.), and C. F. Booth, O.B.E., at 6.0 on February 6th, at the James Watt Memorial Institute, Great Charles Street, Birmingham. (Joint meeting with the Institution of Post Office Electrical Engineers.)

*Western Centre.*—"Magnetic Amplifiers," by A. G. Milnes, M.Sc. (Eng.), at 6.0 on February 6th, at Electricity House, Colston Avenue, Bristol.

Faraday lecture on "Radar," by R. A. Smith, M.A., Ph.D. at 6.30 on February 13th, at the Guildhall, Swansea.

*London Students' Section.*—"Blind Landing," by T. E. Schlizzi, B.A., on February 1st.

Address by the President, Prof. E. B. Moullin, M.A., Sc.D., on February 20th.

Both Student meetings will be held at 7.0 at the I.E.E., Savoy Place, London, W.C.2.

### British Institution of Radio Engineers

*London Section.*—"Travelling-Wave Tubes," by R. L. Kompfner, at 6.30 on February 23rd, at the London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1.

*West Midlands Section.*—"Electronics and the Brain," by H. W. Shipton at 7.0 on February 22nd, at the Wolverhampton and Staffordshire Technical College, Wulfruna Street, Wolverhampton.

*Scottish Section.*—"The Performance and Stability of Permanent Magnets," by A. J. Tyrrell, at 6.45 on February 2nd, at the Institution of Engineers and Shipbuilders, Glasgow.

*Merseyside Section.*—"The Measurement of Small Currents," by D. R. Hardy, M.Sc. (Eng.), at 7.0 on February 1st, at the Accountants' Hall, Derby Square, Liverpool.

*North-Eastern Section.*—"Single-Sideband Systems Applied to Long-Range Wireless," by Major S. R. Rickman, at 6.0 on February 15th, at Neville Hall, Westgate Road, Newcastle-on-Tyne.

### Television Society

*London Meeting.*—Demonstration and discussion on television aids—polaroid lenses, filters, aerials and interference suppressors at 7.0 on February 24th, at the Cinema Exhibitors' Association, 164 Shaftesbury Avenue, London, W.C.2.

*Constructors' Group.*—"Mullard Projection Receiver," by Emlyn Jones (Mullard), at 7.0 on February 9th, at the C.E.A., 164 Shaftesbury Avenue, London, W.C.2.

*Midlands Centre.*—"The V.H.F. Link," by A. H. Mumford (Post Office, Radio Branch), at 7.0 on February 9th, in the Lecture Hall, The Crown Restaurant, Corporation Street, Birmingham.

*Bristol and S.W. Centre.*—"The *Electronic Engineering* Televisor," by W. I. Flack, at 7.30 on February 7th, at the Royal Hotel, Bristol.

### British Sound Recording Association

"High Quality Reproduction—How to Achieve It," by H. J. Leak, at 7.0 on February 24th, at the Royal Society of Arts, John Adam Street, London, W.C.2.

### Radio Society of Great Britain

"Panoramic Reception," by B. H. Briggs, M.A. (G2FJD), at 6.30 on February 24th, at the I.E.E., Savoy Place, London, W.C.2.

### Institute of Navigation

A symposium of papers on air traffic control at 4.0 on February 17th, at the Royal Geographical Society, 1, Kensington Gore, London, S.W.1.

### Guild of Radio Service Engineers

*Edinburgh Branch.*—"Valves and the Service Engineer," by D. N. S. Toms (Standard Telephones & Cables), at 7.30 on January 26th.

Lecture by F. Henderson of the Osram Valve Department at 7.30 on February 23rd.

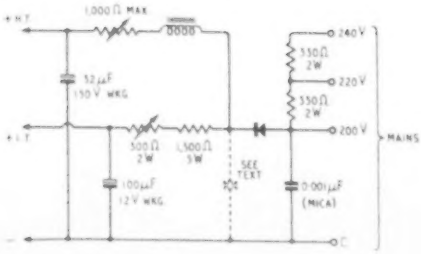
Both meetings will be held at Unity House, 4 Hillside Crescent, Edinburgh.

## "A.C./D.C.-Battery Power Supplies"

### *An Important Correction*

IN Fig. 1 of the article on page 31 of the January issue it is regretted that incorrect values were given for some resistors in the l.t. and mains voltage adjustment circuits. The corrected circuit is reproduced herewith.

It should also be emphasized that the method of "losing" surplus mains voltage, involving the omission of the rectifier reservoir capacitor, applies only to a.c. mains and this particular circuit should not be used on a d.c. supply.

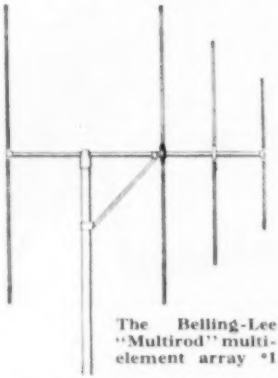


# THE "BELLING-LEE" PAGE

## Providing technical information, service and advice in relation to our products and the suppression of electrical interference

### The "Belling-Lee" Mobile Research Unit

For many months we have had this unit in commission, touring the country taking field strength measurements, polar diagrams of aerials etc. It is fully equipped for work of this kind, and has been examined by numbers of technically interested people in locations as far apart as Stoke-on-Trent and Bristol. Early in the New Year this research unit



**The Belling-Lee "Multirod" multi-element array *1**

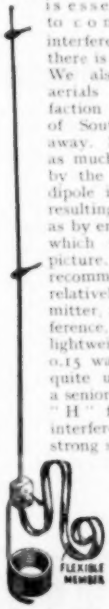
will start out on a planned tour of the fringe areas of Sutton Coldfield with a view to obtaining authoritative information as to reception conditions in various localities. The same aerial system will be used for all tests at a constant height (30ft.) from the ground to ensure uniformity of conditions. Field strength measurements will be taken and reception received on two standard communal receivers having respective peak white sensitivities of 50 and 150 microvolts. From the results we will be able to state, with considerable assurance, the general reception potentialities of the district taking into consideration high and low topographical locations.

This survey should give a fair indication of the most likely types of aerials which should be stocked by dealers in order to cope with local variations of signal strength.

This information will be made available to everyone as soon as it comes to hand.

### "H" Type or Simple Dipole.

We are constantly reading provincial and other press notices where writers deprecate the selling of "H" type aerials within, say, twenty miles from a television transmitter. We agree most heartily, but we feel it quite wrong to make such a statement without qualification. A simple dipole, outdoor or indoor, is useless where interference is strong, regardless of the distance from the transmitter. We know of many cases within a few miles of Alexandra Palace, where an "H" type is essential to combat interference, and we all know there is a lot of interference. We also know of indoor aerials giving every satisfaction in residential parts of Southend, thirty miles away. In our opinion quite as much harm can be done by the erection of a single dipole in the wrong place, resulting in a bad picture, as by erecting an "H" type which would give a clear picture. When we have to recommend an "H" type relatively close to a transmitter, and to combat interference, we suggest our lightweight range with 0.15 wave-spacing*2. It is quite unnecessary to instal a senior quarter-wave spaced "H" for the reduction of interference in localities of strong signal.

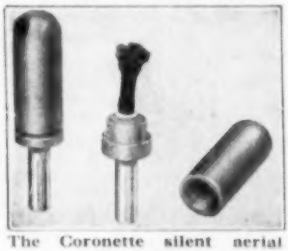



### Strong Signal on "Doorod"

Reports have come in of too strong signal on "Doorods" *3. It should be quite unnecessary to fit attenuators to such aerials. If the flexible element is fixed at right angles to the vertical element, i.e. horizontal, the "Doorod" will only have half the pick-up. The flexible element may be folded, or brought still closer to the vertical element to cut down the efficiency still further. To quote an extreme case, if used as an inverted "V" and orientated at right angles to the transmitter, little or no signal should be received.

### "Coronette"

This silent aerial discharger is gaining in popularity. We heard that in the Bristol area a good vertical aerial installation was always a source of potential trouble from rain static until the "Coronette" *4 made its appearance. In this area our informant told us



**The Coronette silent aerial discharger**

that they were a hundred per cent effective. From the report we would judge that the intensity of rain static is not so severe in this area as in some other districts. The "Coronette" reduces the trouble by some 40 db's. If the interference is very severe, the residue may still be troublesome.

*1 **"MULTIROD"** multi-element array for fringe areas with 14ft. × 2in. dia. light alloy mast.
London **L698,** Midland **L699, £13 18s. 0d.**

*2 **"VIEWROD"** 0.15 spaced "H" type aerials.
London **L700,** Midland **L701.**
With suffixes below.
/**C** for own mast, **50s.**
/**W** Mast, wall fixing, **75s.**
/**L** Mast, 1 lashing, **87s. 6d.**

*3 **"DOOROD"** full sized half-wave television aerial for use indoors.
London **L645,** Midland **L678.**
With suffixes below.
/**1** with coaxial feeder, **30s.**
/**2** with balanced twin, **26s. 6d.**

*4 **"CORONETTE"** silent aerial discharger.
**L643, 4s. 9d.**

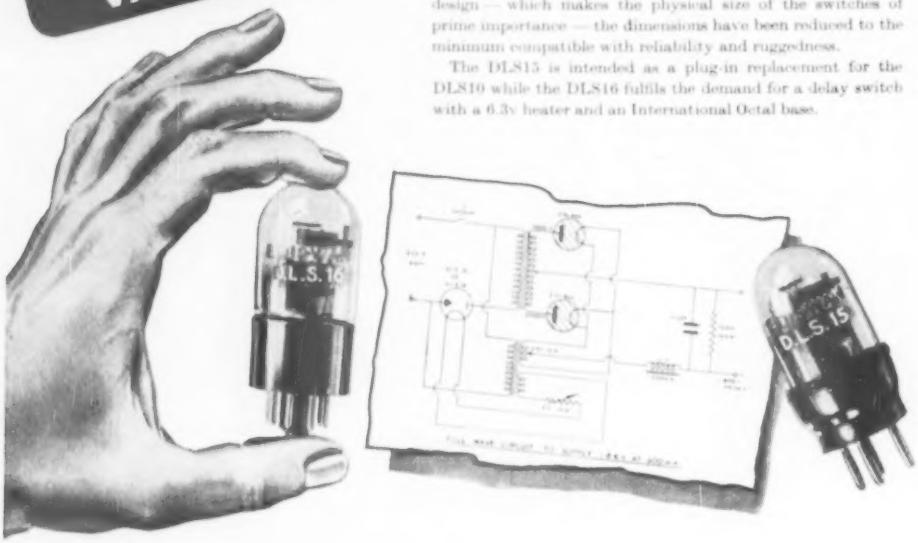
**BELLING & LEE LTD**
CAMBRIDGE ARTERIAL RD. ENFIELD, MIDDX., ENGLAND

EDISWAN
SPECIAL PURPOSE
VALVES

## Smaller Vacuum Thermal Delay Switches

These two new delay switches are recommended for use wherever a switching delay of 30-180 secs. is required. They have been developed for use in applications similar to those of the EDISWAN DLS10 but, in line with modern equipment design — which makes the physical size of the switches of prime importance — the dimensions have been reduced to the minimum compatible with reliability and ruggedness.

The DLS15 is intended as a plug-in replacement for the DLS10 while the DLS16 fulfils the demand for a delay switch with a 6.3v heater and an International Octal base.




**DLS15 Rating.**

Filament Voltage (volts) ... ... ... ... 4

Filament Current (amps) ... ... ... 0.75*

Delay time at 4 volts (secs.) ... Min. 30 ; Max. 90

*(Delay time may be increased to 180 secs. by variation of filament voltage)*

Maximum Peak Current (low voltage rating) 5 amps at 240v.

Maximum Peak Current (high voltage rating) 100mA at 1 kv.

Maximum overall length (not including pins) 60 mm.

**at approximately 4 volts*

**DLS16 Rating.**

Filament Voltage (volts) ... ... ... ... 6.3

Filament Current (amps) ... ... ... 0.48*

Delay time at 6.3 volts (secs.) ... Min. 30 ; Max. 90

*(Delay time may be increased to 180 secs. by variation of filament voltage)*

Maximum Peak Current (low voltage rating) 5 amps at 240v.

Maximum Peak Current (high voltage rating) 100mA at 240v.

Maximum overall length (not including pins) 65 mm.

**at approximately 6.3 volts*

# EDISWAN

THE EDISON SWAN ELECTRIC CO. LTD., 155 CHARING CROSS ROAD, LONDON, W.C.2

R.A.191

# FILTERS

By "CATHODE RAY"

## 2. *Debunking the Cosh—and Other Mathematical Weapons*

FOR the sake of those who haven't read Part 1 (and perhaps of some who did) I will start by recapitulating. We found that unless the calculation of filters is to be unbearably tedious or mathematically advanced it is necessary for the load impedance to be related to the impedances of the filter components in a special way. The main result of this relationship is that the impedance measured at the input of every section of the filter is the same, and equal to the load impedance. This particular value of impedance is called the characteristic or iterative impedance and denoted by $Z_0$. Directly the form of the filter (T, $\pi$, etc.) has been settled, one can write down an equation connecting $Z_0$ with the impedances of its "arms." For a T section, for example, it is

$$Z_0 = \sqrt{Z_1 Z_2}\sqrt{1 + \frac{Z_1}{4Z_2}} \quad \ldots \quad \ldots \quad \ldots \quad (1)$$

where $Z_1$ and $Z_2$ are respectively the total series and shunt impedances of the filter section. In a simple low-pass section, as shown in Fig. 1, $Z_1 = j\omega L$ and $Z_2 = 1/j\omega C$, and when these are substituted in (1) we get

$$Z_0 = \sqrt{\frac{L}{C}}\sqrt{1 - \frac{\omega^2 LC}{4}} \quad \ldots \quad \ldots \quad \ldots \quad (2)$$

We noted that the first factor, $\sqrt{L/C}$, is a constant depending on the filter components, and is multiplied by a second factor which depends on frequency (since $\omega = 2\pi f$). If the frequency is zero, $Z_0$ is just $\sqrt{L/C}$, a resistance. As the frequency rises, this resistance drops to zero at a certain critical frequency $1/\pi\sqrt{LC}$ (because it makes $\omega^2 LC/4 = 1$). Above that it is a pure inductive reactance, increasing steadily. All this can best be seen by drawing the graph, Fig. 2.

We had taken note of the awkward fact that no practical load behaves in exactly this way, and what most people do is just to use a resistance of $\sqrt{L/C}$ ohms, which is correct at very low frequencies but causes a mismatch at other frequencies. (Usually of course, the procedure is vice versa: you are given a load of, say, 1000 ohms, and you choose filter components such that $\sqrt{L/C} = 1000$.) The results of a mismatch remained to be revealed, and so did the all-important question of how the attenuation of a filter varies with frequency.

### Non-Mathematicians Read on!

It is at this crucial stage in the argument that the less mathematically advanced students tantalizingly lose consciousness as a result of a well-aimed blow with a cosh; in other words, the writer resorts to hyberbolic functions. As I said before, coshes and other hyberbolic functions are no more difficult to look up in tables than sines and coses, but the reason for bringing them in at all is not always transparently clear. It is possible to dodge this issue a little longer, however, and at the same time see something of the answer.

Considering first of all the part of the curve in Fig. 2 up to where the frequency is $1/\pi\sqrt{LC}$, we see that $Z_0$ is a pure resistance. Therefore all the power put into the filter must be dissipated somewhere. The filter itself has no resistance, so the only place where the power can be dissipated is the load, which (being equal to $Z_0$) is of course a resistance. If all the power goes right through the filter without loss, there can be no attenuation. So up to a certain frequency—which, you may note, you can make what you like by a suitable choice of component values, because it is $1/\pi\sqrt{LC}$—the filter doesn't attenuate at all. That is one remarkable fact that can be arrived at simply from the most elementary principles. (But remember the load resistance has to vary with frequency according to the curve in Fig. 2.)

You can see at once from Fig. 1 that there should be no attenuation at zero frequency; the impedance of the series arms is nil and the shunt arm infinity. It is not nearly so easy to see why it should be so at other frequencies. A.c. flowing through the coils is bound to cause a voltage drop, and, with the load resistance falling, the current will tend to increase and cause the drop to be greater. So how can the insertion of the filter have no effect? The explanation is that this increasing voltage drop across $Z_1$ is exactly

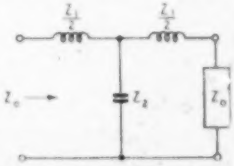



Fig. 1. The type of filter section being considered — a low-pass T—terminated by its characteristic impedance $Z_0$ (see Fig. 2).

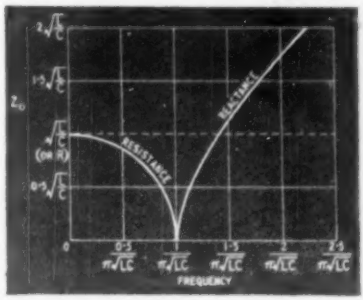



Fig. 2. How the characteristic impedance of the Fig. 1 type of section varies with frequency.

offset by a tendency to resonate with $Z_2$. As you know, in a resonant circuit the voltages across the reactances can each be much larger than the input voltage. And the effect of the load resistance is to keep the input current exactly in phase with the voltage at all pass frequencies. It is a fascinating thing to ponder over.

Next, what is the significance of the critical frequency where $Z_0$ drops to zero (or soars to infinity in the $\pi$ type)? Its formula, $1/\pi\sqrt{LC}$ will almost certainly have rung a bell by now—or perhaps half rung it? It is so very like $1/2\pi\sqrt{LC}$, the formula for the frequency at which a series circuit made up of L and C resonates. The coincidence is too remarkable to mean nothing; but why should the 2 be missing? In other words, why should the filter's critical frequency be double the resonant frequency?

Looking at Fig. 1 and drawing in the load and generator resistances, which at this frequency must both be zero, we find that the two series arms, each made up of L/2 come in parallel with one another and with C. The total inductance in parallel with C is therefore L/4, and if you substitute L/4 for L in the resonance formula you find the resonant frequency comes out as $1/\pi\sqrt{LC}$. So this mysterious critical frequency *is* where the filter resonates!

The same conclusion can be arrived at by considering a $\pi$ section, Fig. 3. At the critical frequency its $Z_0$ rises to infinity, so it can be regarded as being open-circuited, just as shown. The two capacitance arms are in series with one another, and as their separate capacitances are C/2 (to make $2Z_2$) the capacitance in parallel with the coil is C/4 and the resonant frequency $1/\pi\sqrt{LC}$, as before.

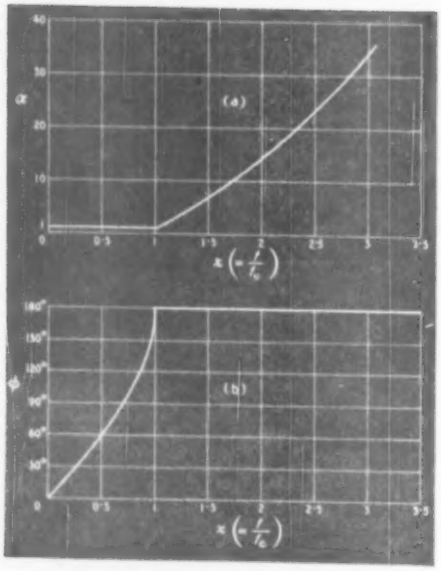
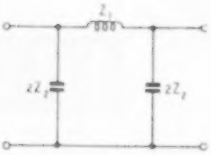



Fig. 4. Attenuation (a) and phase angle (b) curves against frequency for a low-pass ladder filter terminated by $Z_0$. Note the abrupt changes at the cut-off frequency (where $f/f_c = 1$).

Fig. 3. Low-pass $\pi$ section.




At all higher frequencies, the filter (and its load) looks to the generator like a pure reactance, which means that no power is accepted. From a power point of view, therefore, it attenuates completely. That does not mean, of course, that no current or voltage can reach the output. And, let us remember, it is based on the rather unpractical assumption that the load suddenly becomes a reactance, whereas in practice it is likely to remain a resistance. Still, if you consider the situation carefully, you may reach the conclusion that above the critical frequency the filter attenuates. Whether you do or not (and don't be worried if it isn't obvious!) it does in fact; so what we have been calling the critical frequency is known as the cut-off frequency, usually denoted by $f_c$ (sometimes $f_0$).

## Algebraical Detour

And now we can really no longer evade what in days gone by would have been called (not very politely) a *pons asinorum*. This is where, as I said, most writers make good their escape by resorting to the cosh. Actually the thing can be done by perfectly straightforward algebra, greatly aided by $j$ (which we saw in the Feb. 1948 issue was not really a difficult trick to acquire). Most things in so-called higher mathematics can be done by straightforward algebra, but they are apt to be so intolerably tedious that way that they never would be done unless neater and shorter methods had been devised. Unfortunately these short cuts look so dangerous to those who have never gone by them before that they prefer to toil around the long but more familiar routes.

I haven't sufficient space to show in full every step of the way in finding the attenuation of a filter, say as in Fig. 1, but here is a sketch plan:

What you want—the attenuation—can be expressed as the ratio of the input and output currents. The input current ($I_i$) divides between $Z_2$ and the second $Z_1/2$ (and $Z_0$) in Fig. 1. The latter part is the output current ($I_0$). So what goes through $Z_2$ must be $I_i - I_0$. Now because $Z_1/2 + Z_0$ and $Z_2$ are in parallel with one another, the voltages across them are obviously the same. The voltage across $Z_2$ is $Z_2\ (I_i - I_0)$ and the voltage across $Z_1/2 + Z_0$ is $I_0\ (Z_1/2 + Z_0)$. As these two are equal, you have a simple equation connecting $I_i$, $I_0$, $Z_1$, $Z_2$ and $Z_0$. $Z_0$ can be expressed in terms of $Z_1$ and $Z_2$ (equations (1) or (2)), and the result can be put into a form showing the attenuation ($I_i/I_0$ or $\alpha$) in terms of $Z_1$ and $Z_2$. So when you have chosen $Z_1$ and $Z_2$ you can find the attenuation. Because $Z_1$ and $Z_2$ depend on frequency you can turn the equation into one connecting $\alpha$ with $f$, and draw a graph of it. And since the section is terminated by $Z_0$, you can use any number of sections and each will have the same attenuation. For two sections the whole attenuation will be $\alpha^2$; for three, $\alpha^3$; and so on. The only tricky part of this algebra is keeping account of the phase. It *could* be done without $j$, but $j$ makes it very much easier. A further simplification is to

generalize the whole thing by putting it in terms of $f/f_c$ instead of $f$. It makes it neater to denote $f/f_c$ by some single letter, say $x$. Then $\omega\sqrt{LC}/2$ can be written simply as $x$. Another dodge is to denote $\sqrt{L/C}$, the zero-frequency $Z_0$, as R. Then $Z_1/2 = j\omega L/2 = jRx$, and $Z_2 = 1/j\omega C = R/j2x$.

The final result of all this manipulation should come out as

$$\alpha = 1 - 2x^2 + j2x\sqrt{1 - x^2} \quad .. \quad .. \quad (3)$$

If you dislike $j$, the alternative is

$$\alpha = \sqrt{(1 - 2x^2)^2 + (2x\sqrt{1 - x^2})^2} \quad .. \quad (4)$$

It looks reasonably simple to substitute various numbers for $x$ and draw up a table connecting $x$ and $\alpha$, from which to draw a graph of attenuation against frequency (relative to cut-off frequency as 1), but there are one or two things.

Starting off with values of $x$ less than 1 (i.e. in what we have reason to believe is the no-attenuation or pass region in a low-pass filter), $\alpha$ calculated by (4) turns out to equal 1 every time. (Remember, (4) gives the magnitude only without regard for phase.) That means that $I_0 = I_f$; so there is no attenuation (Fig. 4(a)).

It is interesting to calculate the phase angle. $1 - 2x^2$ is the in-phase component, and $2x\sqrt{1 - x^2}$ the 90° component, so $2x\sqrt{1 - x^2}/(1 - 2x^2)$ is the tangent of the phase angle. Having calculated this, we can find the angle from a table of tangents. The result of this investigation shows that the output current starts off in phase at zero-frequency ($x = 0$), and increases steadily to 180° at the cut-off frequency ($x = 1$), as in Fig. 4(b). (Incidentally, the shape of this part of the curve is a quarter of a sine wave stood up on end.)

So in the pass region the filter doesn't attenuate but it does shift the phase.

Directly we start putting $x =$ more than 1 in (3) or (4) we encounter the square root of a negative quantity. This brings the $j$-less users of (4) to a complete standstill, but the $j$ men carry on merrily with (3) by substituting $-2x\sqrt{x^2 - 1}$ for $j2x\sqrt{1 - x^2}$, and the whole equation now appears as

$$\alpha = -(2x^2 - 1 + 2x\sqrt{x^2 - 1}) \quad .. \quad .. \quad (3a)$$

The minus sign signifies what we already know for $x = 1$, namely, that the output current is 180° out of phase with the input. And as $j$ is absent for all values of $x > 1$ we see that the phase remains constant at this, as shown by the flat top in Fig. 4(b). The magnitude of $\alpha$ can be calculated straightforwardly now, and rises in a curve as shown in Fig. 4(a).

So now we have full details of the performance of one or any number of low-pass filter sections terminated by $Z_0$; and can easily adapt the method to apply to high-pass filters, and (a little less easily) to band filters. And all without a trace of a cosh or a $e^x$ or any such-like fearsome apparition! Are these things merely to frighten possible intruders away from the filter experts' "closed shop"?

The answer lies in the amount of time and effort you have expended in working out the data for Fig. 4 from equation (3) and (3a)—supposing you have been painstaking enough to have done it. The hyperbolic man just takes a good look at the equation and says "Catch me doing all that work! Why; can't you see? $\cosh \log_e \alpha = 2x^2 - 1$!" And so he looks up his table of coshes, and then finds $\alpha$ from his $\log_e$ table or, if he is that sort of man, he will probably not

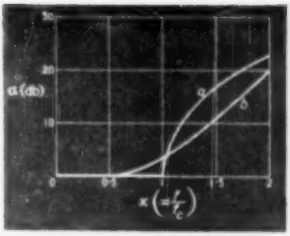



Fig. 5. Attenuation curves for a filter terminated (a) correctly by the theoretical $Z_0$—this is the same as Fig. 4(a) but to a decibel scale this time—and (b) by the practical load resistance $R (= \sqrt{L/C})$.

bother, but just call the $\log_e \alpha$ figures the attenuation in "nepers"—units each equal to 8.686 decibels).

The practical value of the cosh, then, lies in the fact that it enables one to dodge most of the work by looking up tables. For instance, when $x = 2$, $2x^2 - 1 = 7$, and the thing that 7 is the cosh of is (from the table) 2.632. Multiplying this by 8.686 gives the attenuation in decibels—22.8, which is 13.9 in $\alpha$ ratio. Anybody can do that without knowing anything about the theory of hyperbolic functions.

If 22.8 db at twice the cut-off frequency is not enough, then just add more sections. Two will give 45.6; three, 68.4, and so on. To design a filter to given requirements one would know $f_c$, the desired cut-off frequency, and also R, the nominal characteristic impedance (at zero-frequency in a low-pass filter). The information we already have gives $L = R/\pi f_c$ and $C = 1/\pi R f_c$—the component values.

## Conditions Near Cut-off

All this is most interesting, but unfortunately it relates to a load impedance that exists only in imagination. It would be much more practical to know what happens when the load is not the fantastically varying $Z_0$ but the solid constant R. Fig. 2 shows that everything would go according to plan at zero frequency (much use that is!) and probably nearly so at all frequencies much lower than $f_c$. But near $f_c$ there is bound to be violent mismatching, and in any case all our beautiful calculations based on $Z_0$ fall down.

That is not to say that they have been a waste of time. As I suggested earlier, the policy is to use this comparatively simple but purely theoretical case as a main framework, and then find out how it is modified by practical conditions such as a constant resistive load and losses in the filter components. Fortunately, the modifications are much less drastic than one might expect. The losses in well-designed filters usually cause a little rounding off near $f_c$ and some reduction in $\alpha$ at the highly-attenuated frequencies. Fig. 5 shows what happens near $f_c$ when $R (= \sqrt{L/C})$ is substituted for $Z_0$ as the load following a single section. For comparison the $Z_0$ curve from Fig. 4(a) is repeated, but both curves in Fig. 5 are plotted to a decibel scale. If the load impedance is very different from R—especially if it is much greater—the departures from the $Z_0$ curve really are drastic; but it is generally not difficult to use R.

When several sections are used the curve becomes rather more complicated, with a noticeable waviness; but it never departs very far from the $Z_0$ curve.

The methods of arriving at the corrected curves are too much to go into here. But we have found what I hope is an intelligible theoretical route, as well as a good short cut, to a performance curve for

the theoretical $Z_0$-terminated filter, and when the sharp corner has been smoothed off slightly it makes a good enough design curve for an R-terminated filter.

If you are more interested in high-pass filters, all you have to do in Figs. 4 and 5 is to substitute $1/x$ for $x$.

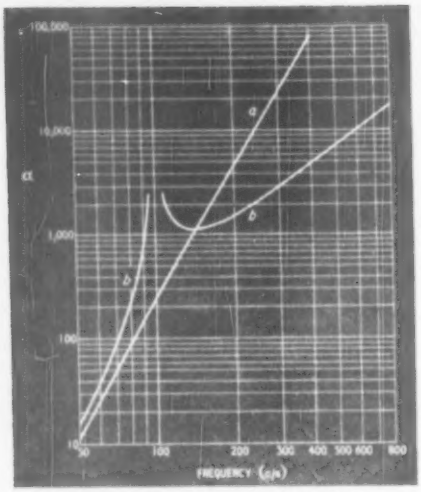
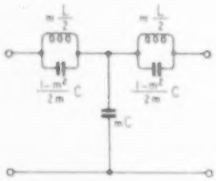



Fig. 6. The attenuation curves we had (Nov. 1949) for a typical smoothing system (*b*) with and (*a*) without choke tuning. This technique is elaborated in m-derived filters.

Fig. 7. One form of m-derived section corresponding to the simple low-pass T. An alternative is to put inductance in series with the vertical arm, to form an acceptor.



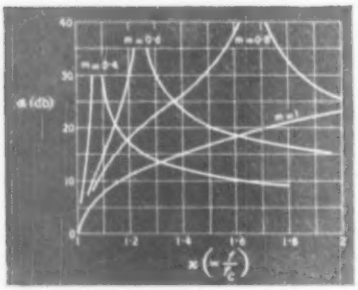




Fig. 8. How the attenuation curves of m-derived sections compare with that of the original "constant-k" (for which m = 1). The cut-off is greatly sharpened at little extra cost.

There are any number of other types of filters (T. H. Turney defines a filter as *any* set of coils and condensers connected up anyhow, with input and output terminals). One of the most important is called the lattice, though it is exactly the same circuit as the Wheatstone bridge, drawn in such a way as to make it difficult to recognize. The only other one I have room to say anything about is a modification of the T and $\pi$ types (collectively termed "ladder" filters). The basic types we have been concentrating on are sometimes called "constant-k" filters. That follows from a practice of denoting $\sqrt{Z_1 Z_2}$ in equation (1) by the letter k; as we have seen, in the case we considered, it is a constant for all frequencies, amounting to $\sqrt{L/C}$. It is, in fact, what we have been calling R. The same applies to the corresponding high-pass filters and also to band filters in which the series and shunt L's and C's are equal.

## m-Derived Filters

There are two objections to constant-k filters. One is that their $Z_0$ varies so much over the pass band (Fig. 2). The other is that if you don't like the attenuation curve (Fig. 5) you have to lump it. Although you can multiply the $\alpha$ scale by using more sections, no adjustment of component values will make the cut-off per section sharper. So if you want to eliminate a frequency quite close to the cut-off with a constant-k filter you have to use an uneconomically large number of sections, which may give far more attenuation at the remoter frequencies than you need. You may remember that three months ago we took note of a useful dodge for getting over this difficulty in the case of smoothing circuits using perhaps as few as two sections, by tuning one of them to reject the undesirable frequency. This dodge converted a rather gradual attenuation curve, (*a* in Fig. 6), into a really sharp cut-off with a peak at the frequency to be rejected (*b*). The fact that the attenuation at remote frequencies is less enormous doesn't usually matter.

In our smoother we just added capacitance across one of the chokes, sufficient to tune it to the offending frequency; and that was almost all there was to it. In filter books they dignify this simple modification with the title "m-derived filter" and devote a whole chapter to it, with several new lots of formulae. What is "m," and why? And what is all the fuss about?

Again, it is not really evidence of a "closed-shop" mentality. With the smoother, we didn't have to bother about what happened between the rejected frequency and zero. And (mainly for that reason) there was no question of matching impedances. But the sort of filter we are talking about now has to refrain from attenuating at all over a predetermined band of frequencies, and then cut off rapidly. To make it do this—and also to be able to predict the results with reasonable accuracy, and avoid mismatching—it is necessary to keep as close as possible to the ideal of working into and out of the characteristic impedance, $Z_0$. It has been found that if, when the constant-k type of section is being modified into the tuned type, the L and C values are altered according to a set plan, it is possible to keep its cut-off frequency and its initial or nominal $Z_0$ (R) unaltered, so that the modified section will match the same load and also other modified or unmodified sections. No

only so, but its $Z_0$ can be made more nearly equal to R over the pass band, so going some way to meeting the other objection to the constant-k type.

The key to the plan is m, where m is the fraction by which the original arm impedances are multiplied or divided. The smaller m is, the closer the resonant frequency is to the cut-off frequency. When m = 1, there is no modification. I am not going into details, because anybody who is interested can look them up, and the rules are very easy to follow. Just as an example of the kind of thing, Fig. 7 shows how the original T section is modified into a "shunt-derived" T section, Fig. 8 shows how the value of m affects the position of the rejected frequency ($f_r$) relative to the cut-off frequency ($f_c$) (the formula is $m = \sqrt{(1 - f_c^2/f_r^2)}$, and Fig. 9 shows how m affects $Z_0$. One can see from Fig. 9 that for keeping $Z_0$ as nearly constant as possible the best m is somewhere between 0.6 and 0.7, making $f_c/f_r$ between 0.8 and 0.7, which may or may not be convenient.

Fig. 7 shows that the capacitance and inductances have been reduced to the fraction m of what they were, and two new capacitances have been introduced to tune the coils. This is not the simplest m-derived section to choose; my only reason is that it is derived from the type we have been considering most, so that (for example) Fig. 9 can be directly compared with Fig. 2. For simplicity one would choose the "shunt-derived $\pi$" (with only one tuned arm) or the "series-derived T" (with an acceptor circuit in the vertical arm). Another possibility is to use half a Fig. 7 section tacked on to a $\pi$ (Fig. 3). If there are several different frequencies to be rejected, several derived sections can be used, each with a different value of m.

A good way of getting a grip of this introduction to filters is to work out the component values to meet any requirements you may care to name. If you have the facilities for constructing filters from the resulting designs and testing them, that of course is the best way of all.

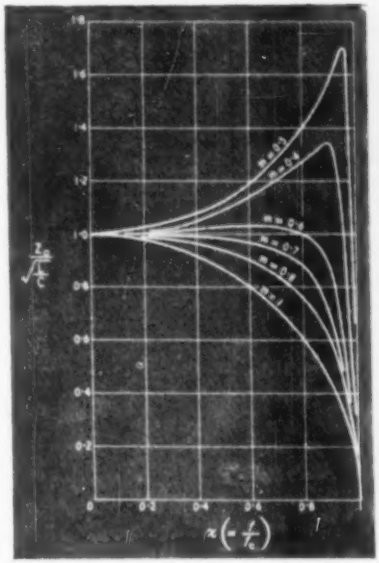



Fig. 9. Characteristic-impedance curves plotted for various values of "m" in Fig. 7.

# Published Reports

## Preferred Valves

Welcome example in limiting the bewildering number of valves at present in use has been set by the Scientific Instrument Manufacturers' Association, in publishing a list of preferred types for electronic instruments. The valves in each category have been chosen to give marked differences of characteristics, and whenever possible to have alternatives in this country or America; whilst in limiting base types, the aim has been to concentrate on International Octal for standard-sized valves and on B7G for miniatures. Characteristics and base connections are given in this booklet, which can be obtained from S.I.M.A., Ltd., 17, Princes Gate, London, S.W.7, price 2s 6d by post.

## Tilts in the Ionosphere

Errors in direction finding at h.f. may be caused by lateral deviations from the great circle path of waves reflected from the $F_2$ layer. Radio Research Special Report No. 19, from the Department of Scientific and Industrial Research, ascribes this effect to random tilting of the layer at the point of reflection, and gives details of observations made with spaced-loop direction-finders on various h.f. broadcasting stations during 1938-1947. The report is published by H.M. Stationery Office, price 10d by post.

## Marine Interference Suppression

A standard of interference suppression for ships is provided by a recently published British Standard (1597:1949), covering frequencies up to 30 Mc/s. It specifies the permissible limits of interference in terms of aerial terminal voltages, lays down conditions for the construction of wireless rooms and gives requirements to be satisfied by the ship's electrical machinery and wiring installation. There are also notes on the components used for suppression. B.S. 1597:1949 is available in booklet form from the British Standards Institution, 24-28, Victoria Street, London, S.W.1, price 4s by post.

## Educational Film

**"High Frequency" Heating,** produced by Merton Park Studios, Ltd., for the British Electrical Development Association, is one of seven films which explain the fundamental principles of familiar electrical effects, and is designed for the age group 13 upwards. It runs for nine minutes and deals with both induction and dielectric heating, showing diagrammatically the process by which heat is generated in each case, and giving practical applications such as case-hardening drills and cooking a loaf of bread. The film, in 16mm. or 35mm., with teaching notes, is available on loan from the Association at 2, Savoy Hill, London, W.C.2.

# UNBIASED

By FREE GRID

## *Radio-Rocket Racket*

IT is now more than half a century since wireless was first used in warfare—field sets were taken by the Army to the Boer war in 1899. Range and reliability were—to use the jungle English of Whitehall—both in short supply and it is not surprising, therefore, that wireless played a very minor rôle in the campaign. It was, in fact, so minor that, as Mr. Churchill tells us, news of the customary early British disasters in warfare was signalled to his incoming ship by more reliable methods. It can be said without fear of contradiction that wireless had no influence whatever on the outcome of the Boer war, whereas on that of the next one it will be decisive.

I am not thinking so much of the radio-guided block-busters, which we may expect from Strelsau should we find ourselves in conflict with Ruritania, but of what I feel sure the popular Press will call "mercy missiles" in the shape of radio-controlled rockets containing food and all the other supplies which in the last two wars had to come to us over the submarine-infested seas.

In using these radio ration rockets for the dispatch of the meat, wheat and wool which we may expect from them, our friends in the Antipodes will, if, in the interests of fuel economy they choose a Great Circle route, obviously have to be careful to select the correct one of the alternatives available to them. If you will give Mercator a miss and plot on a W.W. Great Circle map the routes between us and the Antipodes you will see why. I speak with some feeling in this matter, for the last time I was "south of sixty" I found that some of the natives were no more friendly to this country than Commander Campbell's Patagonians and they might attempt, therefore, to deal with the rockets as the Ancient Mariner did with the albatross in these latitudes except, of course, that they would use micro-wave guns instead of a cross-bow.

"South of Sixty."

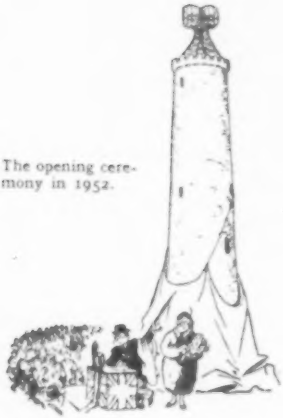
I am laying some stress on the viewpoint that the beneficent rôle of radio rockets will far outweigh any "maleficence" (what a word!), because I think that the other point of view is, and always has been, over-emphasized in the Press and elsewhere; so much so that it is justifiable to call it a radio-rocket racket. As long ago as 1911 there was a display at Earls Court of model radio-controlled aircraft dropping radio-released bombs, and even this venerable journal, in its report of the matter, did not see fit to point out that the bombs might just as well have been sacks of ground-nuts or barrels of dehydrated beer. I would point out, too, that the radio-controlled rockets, which bring the much-needed manna, could, if necessary, be used on their return journey to evacuate the women and children.

I trust, therefore, that people will more and more realize that no matter whether we find ourselves in conflict with Ruritania or Erewhon, or at peace with all men, "radio is on our side" as it has always been.

## *Looking Ahead*

WE are now well into 1950, but not in the second half of the 20th century, as so many people seem to think. It is perhaps scarcely surprising that they think so when the editor of one of our most widely circulated national "dailies" thinks so too, and has produced special editions to celebrate his error. I do not, of course, intend any reflection on his integrity, for editors are, above all, men of honour and wield the blue pencil mercilessly on anything they believe to be lacking in accuracy. Some of them, however, are a little weak in their arithmetic and, in the case of editors of specialist journals, also somewhat lacking in knowledge of matters outside their immediate ken, so that they accept without question statements made by their contributors.

A remarkable instance of this in the realm of radio occurred shortly before the opening of the Sutton Coldfield television station. Several



The opening ceremony in 1952.

Midland newspapers, the editors of which had obviously never heard of d.c. television receivers, made the wild statement that residents in certain areas in the neighbourhood of the station would be denied television because of their lack of a.c. It is true that they were repeating words attributed to the chairman of the local Electricity Board, but surely editors know that the utterances of administrators on technical matters are often no more to be trusted than those of Mr Bevan on the treatment of chilblains.

Not only do some lay editors get their radio facts wrong, but they omit to bring to public attention things which cry out aloud for it. I refer more particularly to the fact that, so far as I am aware, not one single newspaper or periodical—including, I am sorry to say, *Wireless World*—has demanded the building of super-television studios on the south bank of the Thames after the shouting and the tumult of the 1951 Festival of Britain has died and its temporary pavilions are one with Nineveh and Tyre. A permanent concert hall is now being erected and a national theatre is planned, but these will take up only a small part of the space available. Surely, with such easy access to the West End, the site is ideal, in contrast to the proposed studios in the remote White City—also a relic of a bygone exhibition.

In addition, the famous Shot Tower is ideally situated for the necessary 30-centimetre link to be erected on top of it. Now is the time to demand this site before other interests stake their claim. In conclusion, I would stake my own claim to be invited to perform the opening ceremony in 1952; in this I have the full support of Mrs. Free Grid, who is, as a matter of fact, already trying to decide what she shall wear on the occasion.

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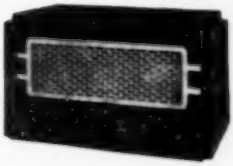

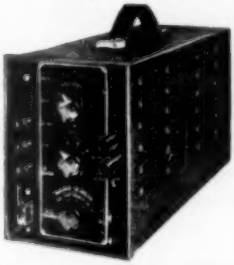

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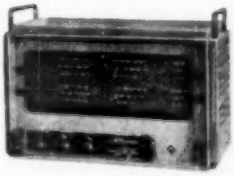

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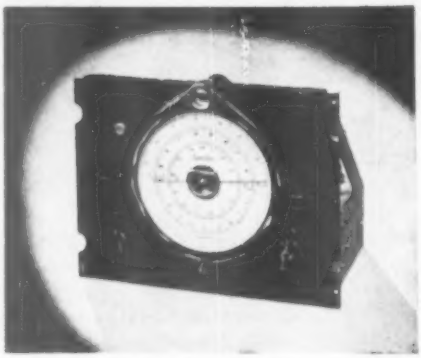

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# Air-Sea Rescue Up-to-Date

*Radio's Rôle in an International Organization*

By BASIL R. CLARKE

Radar scanner on one of the Ocean Weather Ships.

ONE of the more successful international achievements, in which radio plays a leading rôle, is the combined Air Sea Rescue system now operating in many parts of the world. The International Civil Aviation Organization is the co-ordinating body responsible for the general planning. The U.K.'s field of operation is the North Atlantic and the waters surrounding our coasts.

A search and rescue operation in which the writer took part was the first, other than rehearsals, under the international scheme and the comparative smoothness with which it ran is a great tribute to the designers of the system.

Rolling gently in the North Atlantic at 61° N. 130° W. the U.K. Ocean Weather Ship *Weather Observer* was carrying out her normal duties as well as standing by for a flight of U.S.A.F. jet aircraft from Iceland to Stornoway. The weather, hitherto good, was deteriorating when at 1600 hrs. a relayed S.O.S. reached her from Prestwick—the control station for that area—giving the estimated position of the *Erik Boye*, a 400-ton Danish steamer in distress, with a shifted cargo and a flooded engine room. The original message from the *Erik Boye*, which was fitted with R.T. only, had been relayed by a Faröes trawler to Thorshavn Radio, which had in turn passed it to Prestwick. The only fault in the system appeared to be the delay between the first distress call and the time that Prestwick was called.

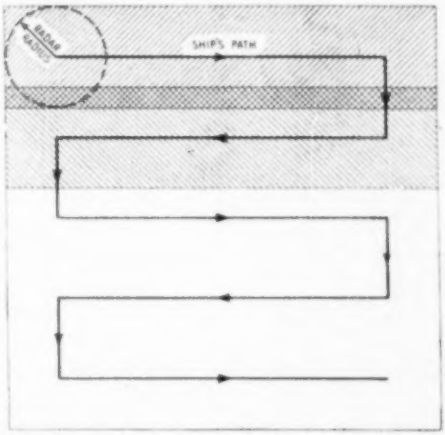
The *Weather Observer* was ordered to proceed to the position, about 200 miles west of the Faröes, and to carry out a visual and radar search. Also in the search were two trawlers and a Danish radar-equipped passenger ship, R.A.F. aircraft from Scotland and U.S.A.F. lifeboat-carrying aircraft from Iceland. Under orders from Prestwick, the *Weather Observer* laid down a plan for a "box" search (see diagram) by the radar-fitted aircraft and ships, thus eliminating any danger of duplication in some areas while leaving others unsearched.

The Ocean Weather Ship was the focal point for all control messages and also provided a positive navigational datum point, her Loran providing a continuous position check for herself, and her Naval radar (Type 277) for the searching aircraft.

At 1000 hrs. the next morning a U.S.A.F. aircraft found the *Erik Boye*, and, having informed the other searchers, settled down to fly in small circles over her, with a radio beacon operating. All the ships immediately began to converge and, as soon as the *Weather Observer* had sighted the distressed ship the aircraft set course for her base. Some 22 hours after the search began four ships were standing by the *Erik Boye*, whose true position was found to be many miles from that originally given.

Radar, a medium-frequency beacon, Loran, m.f. and v.h.f. direction finding, m.f., h.f. and v.h.f. telephony, and long-range high-frequency c.w., all played their part in a rescue in which a Danish ship was sought by British, Danish and Faröes ships, British aircraft from Scotland and American aircraft operating from an Icelandic base.

General principle of the "box" search system. The same method is employed by aircraft using A.S.V. or visual methods.



# Midget Three-Valve A.C. Mains Receiver

*Adding Long Waves and a Stage of Tuned R.F. Amplification to the Original Two-Valve Receiver*

By S. W. AMOS, B.Sc. (Hons.), Grad.I.E.E. (*Engineering Training Department, British Broadcasting Corporation*)

THE article in the March, 1949, issue on a midget 2-valve a.c. mains receiver aroused much interest and the author has received many requests from readers for guidance in adding an r.f. stage, a long-wave band or both to the receiver. These requirements are met in the t.r.f. model described in this article; it is a 2-band receiver using EF50's in r.f., detector and output stages. The sensitivity is markedly superior to that of the 2-valve receiver and is such that worthwhile results can be obtained on signals of less than 100 $\mu$V amplitude; it should be adequate for reception of B.B.C. programmes in most parts of the country whereas the original 2-valve receiver was intended for use only near high-powered transmitters. The new receiver, illustrated in the accompanying photographs, is constructed on a chassis measuring 9in × 5in × 2½in, the overall height being 6½in. The 5-in diameter loudspeaker used with the new model is larger than on the original receiver and gives better quality. The total cost of the components for the new receiver is about £4 5s.

The circuit is given in Fig. 1; it has much in common with that of the 2-valve receiver and comparatively few additional components are necessary to modify the original set to the t.r.f. circuit. Tuning is by a 2-gang variable capacitor and the tuning inductors have standard values, commercial dual-range coils (Denco type C) being used in aerial and intervalve circuits. To give high selectivity and to minimize the effects of different aerial constants on the first turned circuit, shunt-capacitance aerial coupling is used, the low voltage gain of this form of coupling being largely offset by the high $g_m$ of the r.f. valve. The primary windings of the aerial r.f. transformer are not used. The 470-ohm resistor $R_3$ is necessary to preserve d.c. continuity in the grid circuit of $V_1$ and also to make the receiver input impedance low at 50 c/s; with a high value of $R_1$, weak signals tend to be modulated at 50 c/s.

EF50 valves are cheap and plentiful and because of their low heater consumption they are used in all stages of the receiver. The use of this valve as r.f. amplifier introduces a problem in controlling gain, because the EF50 is not a variable-mu valve, and whatever form of gain control is used must prevent overloading of the leaky-grid detector. The method finally adopted is shown in Fig. 1; a 50-kΩ potentiometer is connected in the primary circuit of the intervalve r.f. transformer and the slider is taken to the anode of $V_1$, this particular circuit being chosen to keep the damping of the detector tuned circuit constant, in spite of variations in gain setting. The gain control gives no protection against overloading of the r.f. amplifier but, of course, this receiver is

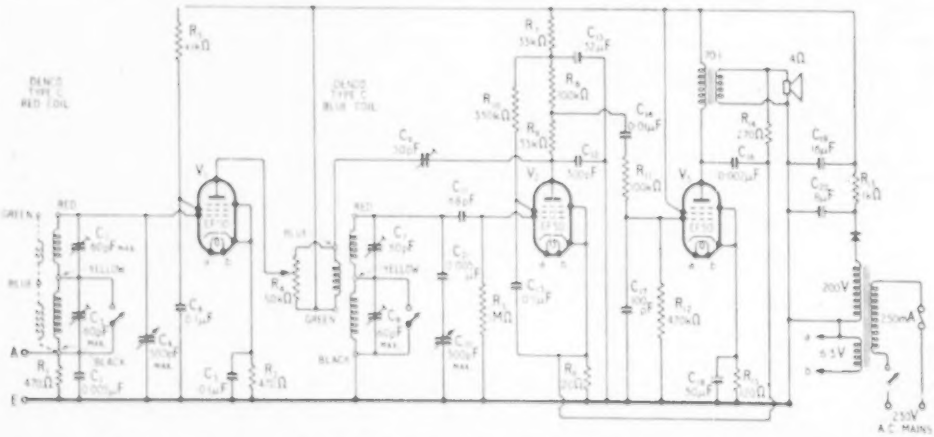
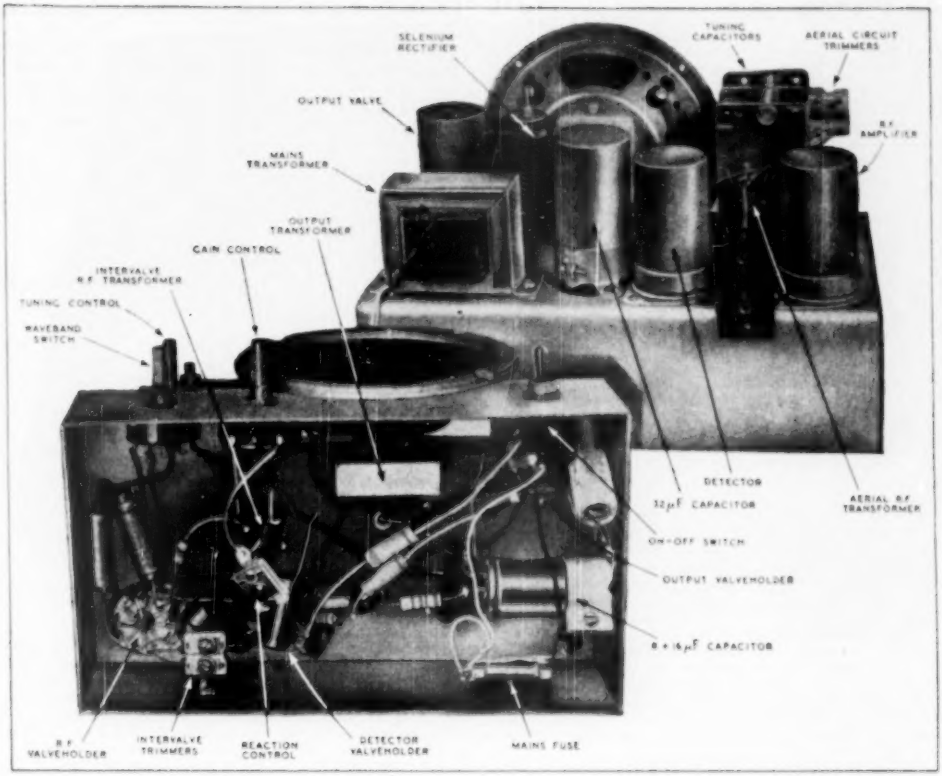



Fig. 1. Complete circuit diagram with component values. All resistors can be of ¼-watt rating.




**Two views showing the general layout of the receiver. To ensure r.f. stability the components in the grid circuit of the r.f. amplifier are mounted above the chassis and those in the detector grid circuit are located on the underside.**

primarily intended for use in areas of comparatively low field strength. Nevertheless, the low voltage gain and high selectivity of the aerial circuit give good protection against overloading of $V_1$ and no symptoms of cross-modulation have been noted using the receiver within a few miles of a high-power transmitter.

Reaction is applied by a small pre-set capacitor; this should be adjusted well below the point of oscillation, but even so gives a useful improvement in gain and selectivity.

The 0.005 μF capacitor $C_{21}$ is included to simulate the aerial-coupling capacitor $C_1$ and makes the effective tuning capacitance in the intervalve and aerial tuning circuits approximately equal, thus ensuring good ganging at the low-frequency ends of the wavebands.

When an r.f. valve is used in the output stage, particular attention must be paid to post-detector r.f. filtering, for even a small r.f. signal in the a.f. amplifier can mar reproduction. Three measures are used to suppress r.f. signals in this receiver: $C_{11}$ shunts the anode load of $V_2$ and reduces the r.f. amplitude there; further attenuation is provided by $R_{11}$ and $C_{17}$; finally $C_{16}$ connected between the anode of $V_3$ and the cathode of $V_2$ gives considerable negative feedback at radio frequencies without affecting the performance at audio frequencies.

As the gain control operates in the r.f. section of the receiver, a fixed amount of voltage negative feedback can be used in the a.f. amplifier and is provided by $R_6$ and $R_{14}$. Fixed feedback is an advantage because it means that less h.t. smoothing is necessary for a given amount of hum; thus it has been found possible to reduce the value of the first smoothing resistor $R_{15}$ from 5 kΩ in the 2-valve model to 1 kΩ in the 3-valve model, yet the hum of the new receiver is less than that of the original. By reducing the value of $R_{15}$ the h.t. voltage is kept reasonably high (170 volts) in spite of the additional drain of the r.f. stage.

Apart from the alteration in the value of $R_{15}$ the mains rectifying and smoothing components are identical with those used in the original receiver.

To align the receiver the trimmers $C_3$ and $C_7$ should first be set to their minimum capacitance and then advanced until a frequency of approximately 1,500 kc/s (200 meters) is received with the tuning capaci-

tors at minimum and the waveband switch set to medium waves. Finally, the trimmers should be accurately adjusted to give maximum output from the receiver on a signal near the high-frequency end of the medium-wave band such as the third programme on 1,474 kc/s. Trimmers $C_7$ and $C_8$ should be adjusted in a similar manner near the high-frequency end of the long-wave band, but on this band the trimmers should first be set at their maximum capacitance otherwise it may prove impossible to receive the low-frequency end of the band. The coil manufacturers (Denco, 355-9, Old Road, Clacton-on-Sea) recommend a trimming capacitance of 70 pF for this band.

With many receivers the addition of an earth lead makes comparatively little improvement in reception, but with this receiver (and with the original 2-valve model) the addition of the earth lead makes a considerable difference, and it is recommended that a good earth connection be used whenever possible. Needless to say, a good aerial should also be used and it is perhaps worth stressing that the calibration and selectivity of this receiver are practically unaffected by the constants of the aerial used.

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# NEW BOOKS

**Radio Aerials.** By E. B. Moullin, M.A., Sc.D. Pp. 514 + xi; figs. 243. Geoffrey Cumberlege, Oxford University Press, Amen House, Warwick Square, London, E.C.4. Price 50s.

THIS is the second volume in a new series of monographs describing recent advances in the scientific field. It deals only with a limited class of radio aerials, but does so in great detail.

The first section of the book is theoretical. The Lorentz vector and scalar retarded potential functions are first established and then applied to specific problems. These include the fields due to filaments, the effect of flat sheet and V-shaped reflectors, and problems relating to cylinders immersed in electromagnetic fields.

Some hypothetical problems are solved rigorously, usually in terms of Bessel functions, and practical problems are considered as approximations—usually very close ones—to the hypothetical cases. The power gain of typical arrays with various current distributions is calculated, and methods of suppressing the side-lobes discussed. A short section is devoted to the isolated aerial.

The remaining one-third of the book describes experimental procedure, and the results of measurements made on some of the aerials described in the first section. Results for V aerials are given in great detail, and include the radiation patterns for various V angles and sizes of sheet.

The reader who is interested in the practical applications of the aerials described, but does not wish to plod through the mathematics, will find plenty of interest in this section, and indeed throughout the book. From time to time the author draws attention to many practical design considerations—how far it is worth while increasing the size of sheet reflectors in order to improve the aerial performance, the permissible tolerance on the shape of the reflector, the use of netting and rods instead of continuous sheet, and similar problems of great importance to the aerial designer. The many examples of measured aerial performance will also be of interest—too little information has in the past been available, both in technical journals and in text books, on this subject.

The treatment is mainly mathematical, however, and the reader will require a reasonable knowledge of mathematics if he is to derive full benefit from this book. It will therefore appeal more to the aerial specialist or post-graduate student. A valuable feature of the book is that the author gives physical interpretations and justifications of his methods, which helps the reader to get the feel of the mathematics.

To sum up, this will be found valuable not only as a book of reference on the types of aerial covered, but also for the clear and logical development of the general theory.

H. P.

**Industrial High Frequency Electric Power** by E. May, B.Sc., A.C.G.I., M.I.E.E. Pp. 355 + xi; figs. 208. Chapman & Hall, 37, Essex St., London, W.C.2. Price 32s.

MOST radio engineers look upon low-frequency alternators as a relatively unimportant part of their power supply equipment. This book leads them all the way from these low-frequency alternators up to the high-frequency oscillators which they are more at home with, and helps to present the whole subject as a single problem and to give a new way of looking at it. It is interesting, for instance, to read of resonance as seen from the eyes of someone who has been brought up to believe it to be an evil thing, which an engineer can by his skill sometimes turn to his advantage.

The examples of equipment and applications in the lower frequency part of this field are well selected and authoritatively presented, and (once one has got over the shock of seeing a 400-cycle alternator called a "high-frequency alternator") can afford a valuable introduction to a subject which has been inadequately covered.

Readers of *Wireless World* will no doubt be more interested in the radio-frequency sections of this book. It must be regretfully said that in these the author is out of his depth. Is it true, for instance, that push-pull oscillators are more frequency-stable than single-sided oscillators? Is not there a risk that they will be more liable to parasitic oscillations? Has Mr. May never heard of parasitic oscillations? Does he really think that one of the reasons for coupled output circuits in high-frequency oscillators is to save d.c. drop in the tank circuit? Do arc oscillators produce damped waves? Spluttery and bubbly, perhaps, but are they damped? Is it necessary to spend a lot of time on idealized graphical solutions of oscillator performance including the usual simplified and quite erroneous load-line treatment only to reach conclusions which are either wrong or irrelevant (such, for instance, as the statement that the anode current is independent of grid drive as long as the grid bias remains constant)?

It is all a great pity; either as a text-book or a reference book about the lower-frequency end of the high-frequency heating problem this work is attractive and one would like to be able to recommend it to radio-frequency engineers as being complementary to their own store of knowledge. But the author has written a book which has one good and one bad half, and the bad half will discredit the good half in the eyes of so many people to whom it would have been useful.

A. H. C.

## Book Received

**Accumulator Charging.** By W. S. Ibbetson, B.Sc., A.M.I.E.E. (Tenth Edition). Detailed treatment of the processes of charging, maintenance and repair. Pp. 190 + xvii; Figs. 41. Sir Isaac Pitman & Sons, Parker Street, London, W.C.2.

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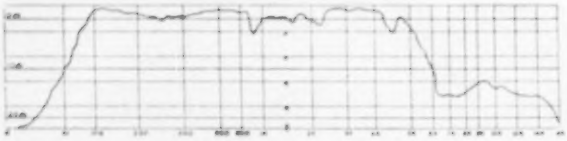

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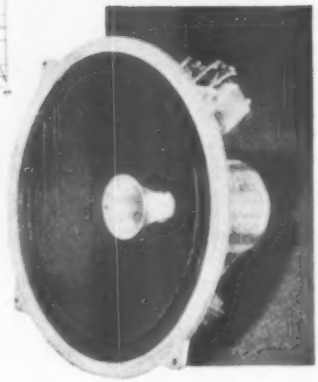

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N.2

# Preferred-Value Attenuators

## *Choosing Suitable Resistors from a Limited Range*

By

**E. W. BERTH-JONES,**

B.Sc.

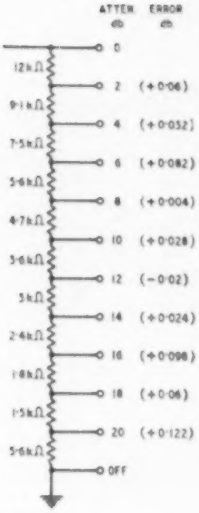



Fig. 1. Potentiometer giving attenuation of 1 db per stud, with maximum errors of − 0.032 db and + 0.054 db. Total grid-earth resistance is 47.3 kΩ.

IN audio engineering the demand often arises for a stepped attenuator in the form of a grid potentiometer, the steps giving equal increments of attenuation of one or more decibels. For many applications the accuracy, and hence the cost, of a commercially obtainable precision attenuator is not justified.

It is perhaps not generally realized that a very useful range of potentiometers can be constructed, using preferred-value carbon resistors and ordinary wafer type switches. The maximum possible error introduced by the preferred values can, for the purposes of computation, be broken down into two components: (a) a maximum standing error of about +0.1 db, representing the difference between the ideal calculated resistance and the nominal value of the nearest preferred resistor; and (b) an error representing the greatest deviation from the *mean error* of all the resistors used. To make (b) a little clearer, we will take an example. Supposing that we decide to use resistors of ±5 per cent tolerance, we may find in practice that all the samples chosen fall between +2 per cent and +4 per cent of their nominal value. The *mean error* of the resistors is then +3 per cent, and the greatest deviation from this is ±1 per cent, representing 0.09 db. So for this particular example we see that the maximum possible error in the attenuator, (a) plus (b), will be 0.1 db + 0.09 db = 0.19 db, say 0.2 db. This assumes the worst case, of course, when both the components (a) and (b) are additive on the same resistor, and in general the actual errors encountered will probably be considerably less than this value.

With the figures quoted in the above example, the overall resistance of the potentiometer will be about 3 per cent above the designed value, due to the mean error in the resistors, but this fact is usually of no consequence. The first example is a potentiometer having a nominal resistance of 50 kΩ, suitable for working into a triode grid. Attenuation is provided in ten steps of 1 db, together with an "off" position.

The appropriate resistance values are as shown in Fig. 1, and it will be noticed that all the figures quoted appear in the list of preferred values. The total resistance works out at 47.3 kΩ, which is sufficiently near the nominal total of 50 kΩ for most practical applications. The resistors are assembled on a single-pole 12-way make-before-break wafer switch, which provides the click action usually desirable with step type attenuators. Obviously this selection of values is equally applicable in any decade, say, for a 500-Ω or 500-kΩ nominal potentiometer, but the values must not be transposed to give other totals.

### Higher Values of Attenuation

Another example sometimes useful is a potentiometer giving attenuation of 10 db per step. Here each two steps give 20 db loss, a resistance ratio of 10:1, so that we require only two values, repeated as often as required in successive decades. Suitable figures are 68 and 22, with 10 between the lowest stud and earth, and a 100-kΩ potentiometer based on these numbers is shown in Fig. 2. The range of attenuation has been limited to 60 db because it is not practicable to exceed this value for normal applications, on account of the peak-signal/noise ratio of the following valve.

In this example it would be permissible to add an extra resistance of 220 kΩ at the upper end to give the potentiometer shown in Fig. 3, which has a total resistance of 320 kΩ. Note that the resistances at the lower end are not changed. Owing to Miller capacity

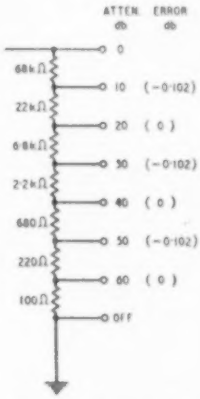



Fig. 2. Potentiometer giving attenuation of 10 db per stud, with a maximum error of − 0.102 db. The total resistance is 100 kΩ.

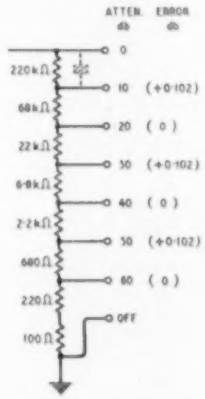
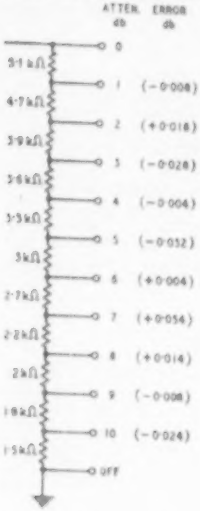



Fig. 3. Potentiometer giving attenuation of 10 db per stud, with a maximum error of + 0.102 db. The total resistance is 320 kΩ.

Fig. 4 (below). Potentiometer giving attenuation of 2 db per stud, with maximum errors of − 0.02 db and + 0.122 db. Total resistance here is 56.8 kΩ.



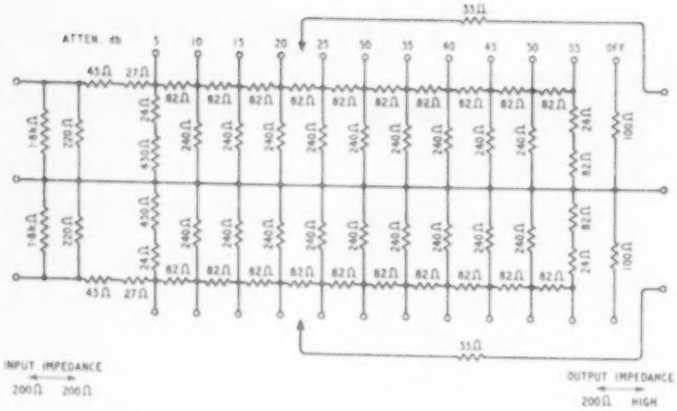




Fig. 5. (Above) Balanced-π attenuator. The resistors have been selected so that the positive and negative errors will alternate.

of the following valve, in combination with such a high value of grid potentiometer, some loss of high frequencies would probably be noticed on the stud giving 10 db attenuation, and a small condenser might be advisable between this stud and the top of the potentiometer, as shown dotted.

Another good example is the potentiometer giving 2 db per stud shown in Fig. 4, which has a total resistance of 56.8 kΩ. This has the useful property that, if extra studs are available, it may be extended either upwards or downwards as required, repeating the resistance values in the next decade, provided due attention is paid to the resistance between the lowest stud and earth.

The examples shown by no means exhaust the possibilities. They may, however, encourage the rather fascinating mental exercise of trying to produce others. As a final illustration, Fig. 5 shows a balanced-π attenuator having an insertion loss of 5 db and attenuation of 5 db per step, with terminations to match a 200-Ω source and present 200 Ω to the load. A 12-way double-bank switch is used, again with make-before-break contacts. With such a network, resistances of positive and negative error should alternate, in order to prevent the error becoming cumulative.

# Choice of Radio Materials

THE high standard of reliability demanded of radio apparatus in its many and varied applications to-day and the consequent necessity for using exactly the right material for each particular job is the reason for the recent publication by the Radio Industry Council of Specification RIC/1000/A. This specification is described as a guide to manufacturers in the choice of materials for radio and electronic equipment and for components used in that equipment. It is intended to provide the industry with help in settling its own materials problems along lines comparable with those on which the Inter-Service Specification RCS/1000 helps the Services to deal with their distinct but similar problems. It is hoped that eventually the relevant sections of both these specifications may be linked together in one national standard to be published by B.S.I.

Specification RIC/1000/A deals with the following subjects: Ferrous metals; aluminium and aluminium alloys; copper and copper alloys; solders; zinc and zinc alloys; plastics (thermo-setting and thermo-plastic); elastomers; inorganic insulating materials; insulating, filling and sealing compounds; textile materials and paper; timber; lubricants; wire and sleeving; miscellaneous materials, including adhesives and fluxes.

The needs of manufacturers of equipment for export are borne in mind, and in many sections of the specification the suitability or otherwise of materials for tropical climates is touched upon.

The specification has been prepared jointly by the Technical Specification Committee of the R.I.C. and the Materials and Finishes Sub-Committee of the R.I.C. in consultation with the British Radio Equipment Manufacturers' Association, the Radio Communication and Electronic Engineering Association and the Radio and Electronic Component Manufacturers' Federation. It has been approved for publication by the Technical Directive Board of the R.I.C. on which all the constituent associations of the R.I.C. are represented.

Copies of the specification are obtainable from the Radio Industry Council, 59, Russell Square, London, W.C.1, for 3s 6d each, post free.

A further guide dealing with "Finishes" is being prepared by the R.I.C., but it is not expected to be completed until well into 1950.

The R.I.C., in conjunction with the Radio Communication and Electronic Engineering Association, have also recently published Specification No. RIC/271/A—Pin Connectors of Piezo-Electric Quartz Crystals mounted in B7G Valve-type Envelopes. A limited number of copies is available from the R.I.C., price 1s.

# Marine Communal Aerials

## *Ship's Distribution Systems Providing Interference-free Reception with Private Receivers*

Communal aerial amplifier for the Redifon distribution system which is capable of feeding 300 private receivers from a single ship's aerial.

THE indiscriminate erection of aerials on board a ship by passengers and crew so that they can use their own wireless receivers at sea is frowned upon by the ship's officers, as, apart from being very unsightly, a host of small aerials can prove a serious source of error in the ship's direction-finding equipment.

A communal aerial is the only satisfactory alternative, but to be really efficient the system must be properly engineered. If an attempt is made to use a large number of receivers on a single aerial without certain precautions being taken many peculiar effects may be encountered. These can take the form of varying signal strength as receivers elsewhere are tuned over the broadcast bands; heterodyne whistles due to leakage of local oscillators into the distribution system; cross modulation; and, in the case of a ship, complete wipe out of all signals whenever the ship's transmitters come into operation. Some, if not all, of these troubles can also be experienced when separate aerials are used.

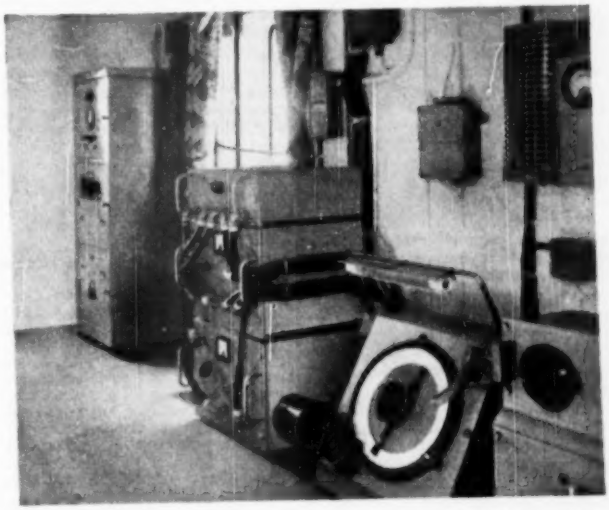
Several of the principal firms in the United Kingdom engaged in installing radio in ships have given this matter their attention and at least two communal aerial systems, which allow trouble-free reception with private sets, have been installed in some of the larger vessels launched recently.

The system evolved by the Marconi International Marine Communication Co. consists of a main unit having three basic output circuits and this is augmented by supplementary units throughout the ship, which vary in number according to the size of the installation.

As it is possible to operate up to three receivers from each of the basic output circuits the main unit alone would serve a total of nine receivers. When more are needed, supplementary units are brought into use and, as each of these has six output circuits each capable of operating up to three receivers, a supplementary unit will cater for eighteen sets. As the supplementary units provide amplification as well as circuit isolation there is no limit to the number of such units that can be employed.

The main unit, to which the aerial is connected, contains the necessary filter and rejector circuits to rid the broadcast signals of interference from the ship's transmitters. After these come a channel splitting stage then a three-channel amplifier. Each channel has a voltage amplifying stage and an output stage and is completely isolated from other channels.

A stage of amplification is used in the supplementary units and this feeds six separate output valves giving an adequate signal in all receivers over the 180- to 550-metre and 12- to 67-metre bands with small gaps as required to prevent interference from the ship's transmitters. There are no



The Marconi communal aerial unit installed between the direction finder and the auto-alarm in the wireless cabin of the cable ship *Edward Wilshaw*.

filters in the supplementary units and all the rejection is effected in the main unit.

All units have self-contained power supplies and are available for either 110V or 220V d.c., or 230V a.c. The power consumption of each unit is between 60W and 110W according to the nature of the supply.

The system designed by Redifon provides optimum working conditions for about 300 receivers in the ship. Incoming signals from the aerial are fed *via* a cathode follower to two wideband amplifiers, one covering the medium- and long-wave bands, and the other the short-wave broadcast bands. The output from each chain is fed to a mixing circuit and thence to three power stages each connected as cathode followers and feeding into separate output lines of from 70 to 150 ohms impedance. The receiving bands provided are 200 to 2,000 metres and 13 to 60 metres, with small gaps where necessary to reject frequency bands required for the ship's transmitters. This equipment is known as the Type A133.

At appropriate points in the system special junction boxes are fitted and in each cabin, or receiving point, is an outlet unit—for matching the receiver input circuit to the line—and the aerial and earth sockets. Isolating capacitors are included in these units so that under no conditions can mains voltages get into the distribution system.

In the Redifon system all amplifiers, filters and rejectors are contained in a single unit which gives about 25 times overall amplification from the aerial to each of the output sockets. An a.c. power pack is also incorporated in the unit and the only external equipment needed, apart from the line apparatus, is a rotary converter to provide the necessary power when an a.c. supply is not available. The whole is housed in a sturdy metal case, measuring approximately 2ft 1½in × 1ft 3in × 1ft 9in, and weighing 115 lb, and fitted with shock-absorbing bushes for bulkhead or desk mounting.

# CONCENTRIC DUPLEX LOUDSPEAKER

## *A Compact Reproducer with a Wide Frequency Range*

BASED on a design originally developed in 1935 by the Whiteley Electrical Radio Company, Victoria Street, Mansfield, Notts., the W/B Concentric Duplex loudspeaker is a small high-quality unit consisting of two moving coils working in separate gaps at either end of a powerful Alcomax III permanent magnet. One coil drives a horn-loaded "spherical" metal diaphragm and the other a 10-inch graduated-fibre cone diaphragm. The "tweeter" horn passes through the centre pole of the magnet and terminates in a non-resonant moulded bakelite flare.

Both coil drives have a pole diameter of 1 inch and the flux densities are 13,000 gauss in the tweeter and 12,000 gauss in the cone drive.

A multi-ratio transformer is fitted, and various combinations of high- and low-frequency matching are possible, since the low-frequency coil impedance is 3 ohms and the high-frequency, 30 ohms. To limit the excursion of the high-frequency diaphragm a 2-μF condenser is in series with the h.f. coil and transformer secondary.

We have heard this loudspeaker in operation and there can be little doubt that the makers' claim of a frequency range of 50 to 14,000 c/s can be substantiated. On the equipment used in the test there seemed to be an excess of medium-high frequencies, but this could no doubt be adjusted by experiment with the matching arrangements. Indeed, it is the accessibility of the connections to the two units and the possibility of experiment with various matching alternatives, or the introduction of more elaborate cross-over filters, which will provide one of the chief attractions for the quality enthusiast.

On a plane baffle the Concentric Duplex gives a clean and full-bodied bass response of surprisingly good quality for a 10-in diaphragm. The diaphragm suspension is also of a type well-suited for use in conjunction with a cabinet of the "bass reflex" type if this is preferred.

The price is £6 6s complete with output transformer and condenser.

A non-resonant and non-magnetic die-cast frame is used to support the low-frequency cone in the W/B Concentric Duplex loudspeaker.

# Responder Beacon

A 200-Mc/s beacon has been designed by Flight Refuelling Ltd., to assist their "tanker" aircraft to locate and intercept "customer" aircraft requiring fuel. It is carried by the "customer" and consists, basically, of a receiver and a pulse transmitter, arranged so that upon reception of an interrogating radar pulse from a Rebecca set in the "tanker," the receiver triggers the pulse transmitter, which radiates a reply pulse.

A notable feature is its long range, which is claimed to be 150 miles air-to-air; this is achieved with a transmitter peak output power of 500 watts and pulses of 5- or 7-μsec duration. If required, the beacon will respond to interrogations from anything up to 25 aircraft.

An automatic coding unit is provided for identification purposes, and can be conveniently pre-set to give any combination of any three Morse characters. Either gap coding (keying the circuit) or pulse-width coding can be selected.

The power unit will operate on the ground from 110-240V mains, or from an 80-115V 1000-c/s aircraft supply.

# LETTERS TO THE EDITOR

*The Editor does not necessarily endorse the opinions expressed by his correspondents.*

## *Radio Exports*

I WAS very interested in the report given by the Commercial Secretariat of the British Embassy here in Tehran (p. 388, your October 1949 issue). So far as the published report goes it is correct but I should like to amplify it.

This country does not seem to be very important in the minds of British exporters of radio equipment, for they do not appear to have studied conditions sufficiently. It is in the interests of Britain that they should pay more attention, for Iran obtains its dollars from sterling; in fact the country can be considered as a "leakage" of Britain's dollars reserve. This "leakage" can be stopped by making British goods more attractive and less expensive than those obtainable from the American market.

How can this be done?

First by ensuring that importers are backed by a good sales and service organization. It is no use handing out agencies without first investigating whether the importer has the ability to sell and service the equipment. I can assure you that here in Tehran agencies seem to have been handed out indiscriminately.

It is realized that a great deal of responsibility must be placed in an agent's hands. The cost of providing a British representative for each firm would in most cases be uneconomical. Why not appoint representatives of the British Radio Equipment Manufacturers' Association to those countries which, as far as radio is concerned, are considered undeveloped? They could advise agents on the most up-to-date methods of demonstration, window display, advertizing, etc., and give lectures on servicing. In fact their job would be to provide a "welfare" organization for British radio equipment in each country.

My second suggestion is that exporters should undertake market research. In most eastern countries the populations can be separated into two sections, i.e., rich and poor. The poor outnumber the rich by ten to one; but who buys the present high-priced receivers? I leave you to answer. Now, what about the poor? All they want to listen to is their own station; no other station interests them. What they want is a small two-valve battery receiver, one waveband and, most important of all, low priced. I say battery, because mains electricity is too expensive to install.

Surely a large manufacturing concern could turn out hundreds of this type of set cheaply, for, this problem not only concerns Iran but all other non-manufacturing countries where a large section of the population is poor.

Battery prices must also come down. A 120-V battery here in Tehran costs between three and four hundred rials (bank rate at present ninety to the pound). Something wrong somewhere!

As regards communication equipment, Iran has recently ordered a considerable quantity of American apparatus for airport installations. British equipment was far too expensive and even since the fall of the pound the prices are not equal. Of this I am assured by the radio engineer at the Tehran airport. Why can't British manufacturers get together and, instead of showing equipment at displays in England, go out and display it in the "wilds." On-the-spot demonstrations, even if in miniature, with good advice thrown in, do more good than all the "at home" displays.

A. J. LIKEMAN.
(Radio Technician to
Imperial Iranian Air Force)
Tehran, Iran.

## "*Watering*"

THE terminology of any branch of technology is important and so I would appreciate an opportunity to comment on your footnote reply to the query in my letter (January, 1950, issue) on the term "watering."

Three authorities on aspects of sound recording/reproduction, consulted independently, say that they have not heard of the term and it is certainly *not* widely used in film recording.

Apart from the accepted term "flutter," the colloquial and onomatopoeic term "wow" is certainly well known in the field, and the following terms are employed occasionally to describe various types of speed fluctuation: "wow-wows," "whine," "whiskers," "waver," "wobble," "gargle" and "drift."

The Sound Committee of the Society of Motion Picture Engineers in 1947 made an extensive study in an effort to reach standardization of flutter and wow terminology and measuring techniques, subsequently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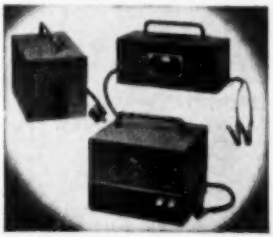

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publishing a long report on its findings (*Journal of the Society of Motion Picture Engineers*, Vol. 49, pp. 147-149, August 1947), but nowhere is the description "watering" mentioned.

Therefore, the derivation and any literature references containing this term that Mr. Berth-Jones can supply would be of great interest to me personally and, I am sure, to the B.S.I. Committee now working on sound recording terminology.

DONALD W. ALDOUS.
Torquay, Devon.

## "*American Hearing Aids*"

I HAVE read with interest the article in your January issue and would like to correct the impression given concerning the newest miniature André-Yardeny type accumulator.

The writer of the article thinks this type of battery has not yet reached the stage where it can be safely entrusted to the public; this view is not shared by my company, who, having subjected these small accumulators to extensive tests over a period of some months, are satisfied that they can provide a reliable and economical low-tension supply for a hearing aid.

The Belclere Monomite P.3 instrument is now available with an accumulator for the l.t. supply, and a charger for the convenience of the user is provided. The accumulator, which costs 9s 6d, should, with ordinary care when recharging, give anything up to two years' service in the instrument.

O. C. LEADBITTER.
John Bell and Croyden, Oxford.

## *Academic Qualifications*

I HAVE experienced some trouble in the past over this matter, and the following may be of interest to your readers.

I am a Graduate of the British Institution of Radio Engineers and hold the Full Technological Certificate of the City and Guilds. I applied some time ago to be placed on the Technical and Scientific Register, but was told that this was for persons with degrees and some professional qualifications, the I.E.E. being included but not the Brit.I.R.E. or the Full Tech. Cert. of the C. and G. I wrote to the Brit.I.R.E., who have been looking into the matter with the appropriate Ministry.

Your correspondent "Bunny" (January issue) may like to know that I obtained employment with the Ministry of Supply as an Assistant Experimental Officer. The rules regarding establishment specify ". . . B.Sc. . . . or the five-year course of the C. and G. . . ."

I am struck by the confusion that exists in the industry and the ministries regarding these various qualifications. I found it necessary when applying for posts to carry a copy of the various syllabuses about with me.

The confusion appears to arise concerning the following qualifications:—(1) Grad. Brit.I.R.E. (2) the old C. and G. exams, viz., Radio Comm. and Tech. Elec. 2. (3) The new C. and G. exams., viz., the Final Cert. and the Full Tech. Cert. The latter may include, for instance, Radio 1, 2, 3, 4, Telecomm. Principles 1, 2, 3, 4, 5 and Maths 1, 2, 3, 4, 5.

It appears to me that a real service could be done to young engineers about to start in the industry if the Brit.I.R.E. and the C. and G. could get together and circularize the various Ministries and private firms with a full statement of the position, giving exact details of the syllabuses etc., especially in view of the recent revision of the C. and G. course and their action in calling one of their group certificates "Final" when it is, in fact, followed by the Full Tech. Cert.

H. C. BERTOYA.
London, E.17.

## "*Easing Impedance Calculations*"

I HAVE read with interest the article by M. G. Scroggie in your January issue on how impedance calculations can rapidly be made by

means of the slide-rule and a rearrangement of the original expression. You may be interested to know that for some years I have used a method of slide-rule operation which is almost the same as Mr. Scroggie's, but which may be slightly more simple in practice. This method is derived from the same source, namely, the well-known expression $1 + \tan^2\theta = \sec^2\theta$.

To calculate an impedance value, take the smaller value of either resistance or reactance and set it on the "C" scale to the left-hand index of the slide-rule. Slide the cursor along to the larger value on the "C" scale. Read off on the "A" scale and add 1, sliding the cursor to this value. The resultant impedance is then indicated on the "C" scale.

The method may be proved by referring to my diagram of the familiar 3,4,5 right-angled triangle. If 3 on the "C" scale is set to the left-hand index and the cursor is moved along to 4, we get $4/3 = 1.33$, which is $\tan\theta$ on the D scale, and $\tan^2\theta = 1.778$ on the "A" scale. To this value 1 is added to give $\sec^2\theta = 2.778$ on "A" and $\sec\theta = 1.667$ on "D." Without further movement of the slide or cursor, $\sec\theta$ is automatically multiplied by 3, which gives the resultant impedance $3 \times 1.667 = 5$ under the hair line on the "C" scale.

ROBERT POLLARD.
London, S.E.26.

## *Pickup Design*

I AM loth to take up more space, but James A. MacHarg's letter (your January issue) and wild statements cannot be allowed to go unchallenged. If he will re-read the article he will find that most of his letter need never have been penned.

I should point out, though, that if a pickup damages or distorts the record surface or groove in any way at all, it will be audible in the reproduction. Therefore a high-fidelity pickup that damages a record cannot be a high-fidelity pickup. Also many readers will know the Danse Macabre recording by Decca that is very popular as a demonstration record. A customer of ours, whose electrical and musical knowledge are beyond question, reports that during eight months' use of the pickup under discussion with a very good amplifier and loudspeaker system, he has played this record, among many others, over forty times without any signs of distortion. This, mark you, on the original sapphire.

T. S. MARSHALL.
London, N.1.

## *Pickup Damage*

IN your December issue J. E. Ellis drew attention to the damage that can be caused to new records during auditions in the shop. Surely the solution is to buy, by post if need be, only from shops which use modern equipment properly.

It is still my view that minimum record wear is achieved with a good lightweight pickup using—dare I say it—miniature thorn needles. If such needles are carefully pointed they seem to be capable of giving reproduction aurally indistinguishable from a new sapphire, and at the same time will play a number of sides of 12-inch records without noticeable deterioration. The Decca "ffrr"

gliding tone test record, for example, is quite reproduceable at 13-14kc/s with these needles.

The thorn point is best used appreciably "sharper" than the normal sapphire point radius. Although this appears theoretically to involve an undesirable lack of "fit" in the groove, in practice no disadvantage appears to ensue. Mr. C. E. Watts' interesting report on the microscopic examination of records, also in your December issue, mentions that during a test, high-quality reproduction of gramophone records was found not to depend on continuous contact between the sides of the groove and the stylus point.

The reputed defects of thorn needles, namely, comparative pliability and rapid wear, seem much less significant when lightweight, lightly damped pickups with moving parts of low inertia are used.

As the above remarks are based on aural tests, I should perhaps say that my reproducer is a simple moving-coil pickup of my own design, amplified by a W.W. Quality Amplifier, feeding a high grade speaker in a reflex cabinet. I realize that such a.f. equipment is not up to the best modern "distortionless" standards, but the differences between the quality of current recordings seem to be incomparably greater than those between different types of good reproducers, and in my experience completely swamp them. These very wide variations in recording quality, even between the products of the same maker, are very puzzling.

A. M. POLLOCK.

Hatch End, Middlesex.

### "*Universal*" *Receivers*

IN your January issue L. Miller suggests series running of 1.4-volt 0.05-amp valves.

It is widely agreed that this practice is generally unsatisfactory, as filament breakdown becomes a frequent occurrence. This is due to the wide tolerance limits of 1.4-volt filaments which vary very greatly from valve to valve.

I have in mind one particular valve (type DAC32) used in a well-known a.c./d.c.-battery portable: it is not unusual to find 2 volts or more across its filament pins with a consequent drop across the filament pins of the remaining valves in the series chain. Very frequent replacement is found to be necessary.

W. G. EVERSHED.

Gomshall, Surrey.

## CLUB NEWS

**Birmingham.**—At the meeting of the Slade Radio Society on February 17th, M. Moston, of the Winter Trading Co., will speak on "Television Components for the Home Constructor." On the 18th members will be visiting the Birmingham Police Radio Headquarters. Meetings are held on alternate Fridays at 7.45 in the Parochial Hall, Broomfield Road, Erdington. Sec.: C. N. Smart, 110, Woolmore Road, Erdington, Birmingham, 23.

**Birmingham.**—At a recent meeting of the Radio-Controlled Models Society the Birmingham Area Group was formed. Details of forthcoming meetings are obtainable from the secretary, G. F. Golding, 32, Beechfield Road, Smethwick, Staffs.

**Cleckheaton.**—At the meeting of the Spen Valley Radio and Television Society on February 1st, H. Clegg (G3FX) will deal with "Unusual Aerials." Meetings are held fortnightly at 7.30 at the Temperance Hall, Cleckheaton. Sec.: N. Pride, 100, Raikes Lane, Birstall, Nr. Leeds.

**Enfield.**—Meetings of the Enfield Radio Society are now held in St. James' Hall, Durants Road, Ponders End, at 7.0 on Mondays. Sec.: F. A. Ticknell, 10, Cowdrey Close, Enfield.

**London.**—The next meeting of the London Area Group of the Radio-Controlled Models Society will be held on February 12th at 2.0 at the St. Ermin's Hotel, Victoria, London, S.W.1. Sec.: Lt. G. C. Chapman, Pine Corner, Heathfield, Sussex.

**Southall.**—A lecture on "Multivibrators" will be given by H. K. Winwood to members of the West Middlesex Amateur Radio Club on February 8th. Meetings are held on the second and fourth Wednesdays of the month at 7.30 at the Labour Hall, Uxbridge Road, Southall. Sec.: H. C. Bostock, 1, Grange Road, Hayes.

**Southend.**—Exhibits for the Pocock cup which is awarded annually to members of the Southend and District Radio Society for home-constructed equipment will be judged on February 24th. Sec.: J. H. Barrance, M.B.E. (G3BUJ), 49, Swanage Road, Southend-on-Sea, Essex.

**Speke.**—The recently formed Speke Radio and Television Society now meets on Fridays in the Stockton Wood Road School. Sec.: H. Timms, 101, Western Avenue, Speke, Lancs.

**Sunderland.**—The chairman of the Sunderland Radio Society, R. V. Duesbury (G3CTE), will address members on "Sensitive Relays" at the meeting on February 8th at 8.0 at Prospect House, Prospect Row, Sunderland. Sec.: C. A. Chester, 38, Westfield Grove, High Barnes, Sunderland.

**Whittington.**—The recently formed Whittington Radio Club meets each Wednesday at 7.0 in the Angel Inn Club Room, South Street, New Whittington. Sec.: W. Watson, 44, Handley Road, New Whittington, Chesterfield, Derbyshire.

**British Amateur Television Club.**—The purpose of this club is to encourage activity by amateurs in television. Particulars of the club, which issues a duplicated magazine called "CQ-TV," are obtainable from M. Barlow (G3CVO), Cheyne Cottage, Dukes Wood Drive, Gerrards Cross, Bucks.


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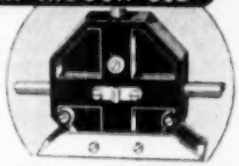

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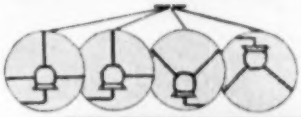

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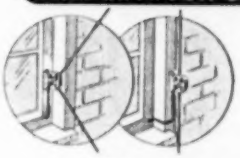

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# RANDOM RADIATIONS

By "DIALLIST"

## *The Clash of Symbols*

AN EMINENT READER of W.W. sheds light on the reason why in some French publications batteries appear in circuit diagrams with short, fat positives and long, thin negatives. This arrangement, he tells me, was widespread on the Continent until a certain international conference was held. The British delegates stuck out for the "thin plus"; but one or two European parties refused to play unless they received something in exchange for their acquiescence. After much thought, our people agreed to make the British symbol for a slow-to-operate relay conform to Continental practice, and honour was satisfied! The position now is that, officially, all European countries have adopted the familiar long, thin line for positive and short, thick line for negative. Some publications, however, prefer to assert their individuality by using fat pluses and thin negatives. Another eminent correspondent mentions that books produced in this country are not wholly guiltless of befogging their readers by misusing the battery symbols. In one fairly recent work all the circuit diagrams show h.t. and l.t. batteries apparently connected the wrong way round! Seems a pity, doesn't it, that we can't achieve unanimity on even so simple a point as this. My sympathies are all with the sorely tried beginner who, having mastered the symbols used in his first book, finds that in the next one he tackles they have just the opposite meanings.

## *Useful Tip*

One of the readers mentioned in the preceding paragraph sends me a convenient way of remembering the polarity of a rectifier as represented in a circuit diagram by its conventional symbol. By "polarity" is meant that of the battery which could be substituted in a power circuit for the rectifier. Here's the tip: Draw the symbol for a single cell, with thin positive and fat negative poles. Whilst thickening-in the negative, permit yourself to indulge in a little mild doodling and shape it into a triangle. The cell now becomes a rectifier with the polarity correctly shown. There's not, of course, any real need to do the doodling. All you have to remember is that in the symbols for cell and rectifier the thin element is the positive and the fat one the negative. That is, naturally, so long as either symbol is correctly used.

## *Sutton Coldfield*

ONE OF THE STRONGEST impressions left by a walk round the Sutton Coldfield transmitting station is of the neatness of its layout and design. There's no wasted space and no overcrowding. The outside of the building can't be described as beautiful, for it is distinctly severe in style. Nevertheless, it is pleasing to look at because its design is functional. A great deal of thought, clearly, went into making the interior of the world's biggest television station as labour-saving as possible from both the engineers' and the cleaners' points of view.

## *Teething Troubles*

An emergency occurred at Sutton Coldfield at a moment which Fate, in one of her most pernickety moods, must have selected specially to bring home to mortal man that he still can't say with certainty, "At such and such a time I shall do this or that." A second or two before the station was due to make its much-heralded opening transmission there was an arc-over in one of the CAT21 triodes of the output stage of the transmitter. The valve didn't "blow up," as was suggested by some lay publications. It was back in service within ten minutes and, so far as I know, it is still doing its stuff. There have been other breakdowns since—in fact Sutton Coldfield has had more than its share of bad luck in this way—but all have been speedily dealt with.

## *Stand-by Apparatus*

One could, of course, guard against the consequences of almost any kind of breakdown by duplicating every stage of the transmitter and by providing automatic switching arrangements to bring stand-by apparatus instantly into use when this part or that of the normal gear went "phut." When I expressed a certain wonder that duplication hadn't been carried further at Sutton Coldfield, it was pointed out that other parts of the country would take a rather poor view of the B.B.C. television development policy if it installed as stand-by apparatus at Sutton Coldfield bits and pieces that should be part and parcel of the main transmitters in other regions. I hadn't quite realized that, whatever its purchasing power, the B.B.C. must take its allotted place in the long queue of those seeking to acquire equipment. That being so, Sutton Coldfield "Paul" could not be equipped with complete stand-by gear without robbing of their birthright the unborn "Peters" in eagerly awaited new


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television service areas. And even as a child one learnt to appreciate what happened when birthrights were bartered away. I could at this point perpetrate a joke about Esau and 'E didn't see—but I refrain.

## *Signs of the Times?*

THE OTHER EVENING I had a telephone call from a friend who lives nearby. Rather diffidently, he asked whether there had been anything in the six o'clock news about something or other—what, exactly, it was I don't remember, though it was, no doubt, very important at the time. "Your wireless set misbehaving?" I asked, when I'd given the desired information. "As a matter of fact," he said, "we haven't a wireless set now." He told me, rather sheepishly, that they'd found just before Christmas that the old wireless set was on its last legs. To recondition it would have cost more than it was worth. They had decided to have a new receiver when their eldest young hopeful pointed out—and kept on pointing out—that it wouldn't cost *all* that much more to have a television set. Having at length given way to his entreaties, they were now discovering with no small chagrin that the televisor can supplement the wireless set, but certainly cannot replace it. I'm hoping that the epidemic won't spread to others of my friends, for I get quite enough telephone calls as it is. And am I acting strictly within the terms of my receiving licence if I "publish" the gist of broadcast programmes over the telephone to inquirers?

## SOLDERING ALUMINIUM

ONE of the reasons for the difficulty of soldering aluminium is its affinity for oxygen and the fact that in air a thin transparent film of oxide forms on the surface immediately after cleaning.

To disrupt this film continuously and thus expose the pure metal to the action of the solder, Mullard Electronic Products, Century House, Shaftesbury Avenue, London, W.C.2, have developed soldering iron (Type E7587), in which the bit is maintained in ultrasonic vibration by means of a magneto-striction transducer powered from a valve oscillator unit. The bit is heated by a conventional resistance winding and of the normal copper type.

Solders with a tin-zinc base are recommended and no flux is required. Ordinary tin-lead solders can be used, but may give rise to subsequent electrolytic corrosion.


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# Manufacturers' Products

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## *Checking Mobile Equipment*

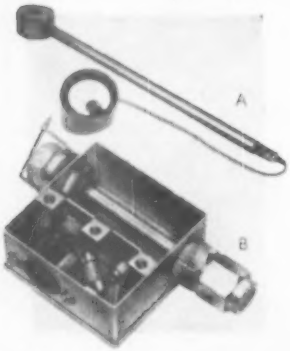
TWO useful pieces of v.h.f. test apparatus for tuning and checking mobile radio installations have been introduced by Mullard Electronic Products, Century House, Shaftesbury Avenue, London, W.C.2. One is a radiation monitor (Type GME501/X) consisting of a current transformer and crystal rectifier housed in an insulated case with a centre hole attached to a long handle, which, when slipped over the whip aerial used on vehicles and "Walkie-Talkies," gives a measurement of aerial radiation.

The actual indicator is a separate 0-500 micro-ammeter, which is used also with the other item, an r.f. tuning indicator (Type GE-506/X). Basically it consists of a short length of concentric line, which is inserted in the aerial feeder at the transmitter end. The line incorporates an r.f. probe and rectifier and measures the voltage on the inner conductor without disturbing the impedance of the line.

This unit is housed in a metal box and is fitted with co-axial sockets for the feeder and plain sockets for the meter connections.

Both indicators can be used with transmitters up to 20 watts output and for frequencies of from 65 to 200 Mc/s.

The aerial monitor costs £3 19 6 and the tuning indicator £2 17 6. The price of the micro-ammeter is £6 13 6.




The Mullard radiation monitor with micro-ammeter is shown above at A, while B depicts the tuning indicator with its cover removed.

## *Television Pattern Generator*

MANUFACTURED by Murphy Radio, this television pattern generator, Type TPG11, provides an r.f. output modulated with a test pattern and sync pulses conforming to the B.B.C. waveform. It therefore enables a receiver to be adjusted in the absence of any transmission so that subsequently it needs nothing beyond the proper setting of the contrast control for proper reception. It should thus be of great value to dealers who can install and adjust sets with its aid outside the hours of television transmission.

On the r.f. side, the generator consists of an oscillator covering 40-70 Mc/s and an amplifier which is suppressor-grid modulated by the required waveform. The output is taken through a 10-db-step ladder attenuator and a continuous control to a coaxial cable. The r.f. output is of the order of 40 mV maximum and up to 65-db attenuation is provided.

The output can be unmodulated, modulated with a 250-c/s square wave or modulated with sync pulses and a pattern. These waveforms are generated by a series of multivibrators and flip-flops which start with a 20,250 c/s multivibrator. Correct frequency is ensured by locking to the mains frequency.

The pattern produced consists of four equally spaced horizontal black bars and one broad vertical black bar. In addition, there are some 26 very narrow vertical grey bars.

Because the sync waveform is correct, a receiver can be adjusted for proper interlace and aspect ratio, while linearity can be adjusted by setting the controls for equal spacing of the pattern bars. By setting the r.f. output at the value corresponding to the field strength in the area, even the contrast control can be set approximately.

The test pattern waveform and the sync pulses are available for video testing and test sockets are provided in case adjustments to the instrument are needed. The generator weighs 30 lb and the power unit, which is separate, 20 lb. The approximate overall dimensions are 18½ in tall by 12½ in by 12 in for the generator and 12 in by 7 in by 7½ in for the power unit. It costs £140 and is sold by F. Livingstone Hogg, 65, Barnsbury St., Islington, London, N.1.

Murphy Radio television pattern generator with its power unit.

## MANUFACTURERS' LITERATURE

CATALOGUE (No. 180) of radio components from A. F. Bulgin & Co., Bye Pass Road, Barking, Essex.

Synopsis of "Cintel" electronic instruments for research and industry from Cinema-Television, Ltd., Worsley Bridge Road, Lower Sydenham, London, S.E.26.

Catalogue of H.M.V. television receivers for the Midland transmitter frequencies, and an illustrated leaflet describing the Model 2103 automatic record player, from the Gramophone Company, Hayes, Middlesex.

Folder giving list of "Somerford" transformers and chokes, including components specified in the Williamson High Quality Amplifier, and a brochure of audio output transformers, from Gardners Radio, Somerford, Christchurch, Hants.

Data sheet of Marconi receiving valves from the Marconiphone Company, Hayes, Middlesex.

"Industrial Photocells"—a 20-page booklet of data on vacuum and gas-filled types, with circuit recommendations—from Mullard Electronic Products, Century House, Shaftesbury Avenue, London, W.C.2.

Illustrated leaflets describing the Type D-365-A Duddell oscillograph; Type A-151-A inductance bridge; Type D-101-A frequency bridge and a universal unit conductivity bridge, from Muirhead & Co., Beckenham, Kent.

# NATIONAL PHYSICAL LABORATORY REPORT

On tests of 12 watt amplifier

marked: "POINT ONE", TL/12. H. J. LEAK & CO. LTD.

Ref. E.388.150. Aug. 30th., 1949

**Test Conditions.** In all cases the input was applied to a 50,000Ω resistor connected to the amplifier by 3 feet of screened cable. The output load was in all cases a resistor of 18Ω and the output transformer secondary windings were connected for the "15Ω — 20Ω" condition.

**HARMONIC DISTORTION.**

0.03% for 10 watts output at 1,000 c/s.
0.1% for 10 watts output at 60 c/s.
2nd and 3rd harmonics predominated, and were approximately equal in magnitude.

**HUM AND NOISE.**

—80 db. referred to 10 watts.

**SENSITIVITY.**

148 mV.r.m.s. input gave 12 watts output at 1000 c/s.

**LOAD DAMPING FACTOR.** (Load impedance/output impedance).

42 for 10 watts output at 1,000 c/s. (Output impedance 0.43Ω).
45 for 2.5 watts output at 1,000 c/s. (Output impedance 0.40Ω).
The output impedance was found to be substantially resistive.

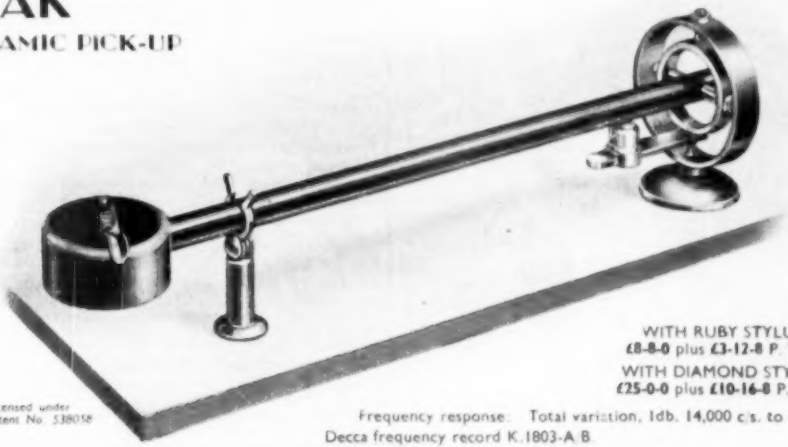
**FREQUENCY RESPONSE.**

Gain relative to that at 1,000 c/s. measured at 7.5 watts output, including the losses introduced at the higher frequencies by the capacitance of the input cable shunting the input resistance of 50,000Ω.

| c/s. | db. |
|---|---|
| 20 | +0.1 |
| 60 — 1,000 | 0 |
| 5,000 | —0.1 |
| 10,000 | —0.3 |
| 15,000 | —0.4 |
| 20,000 | —0.7 |

WRITE FOR BOOKLET W/TL/12 which explains how these results are achieved.

THE
# LEAK
DYNAMIC PICK-UP



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**£8-8-0** plus **£3-12-8** P. TAX
WITH DIAMOND STYLUS
**£25-0-0** plus **£10-16-8** P. TAX

Licensed under Patent No. 538058

Frequency response: Total variation, 1db. 14,000 c/s. to 40 c/s. from Decca frequency record K.1803-A/B.

In mechanical detail and electrical performance the LEAK DYNAMIC PICK-UP is as far ahead of other pick-ups as the LEAK "POINT ONE" TL/12 AMPLIFIER is ahead of other amplifiers.

WRITE FOR LEAFLET W/P.

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No wonder then that more and more Police authorities throughout the country are using G.E.C. quartz crystals in their radio equipment.

Pioneering research and experience in making over a million units, ensure a product of the highest quality. For all your quartz crystal requirements be sure to specify G.E.C.

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# LAWRENCES

## NEW RADAR EQUIPMENT

### MODEL VG RADAR INDICATING EQUIPMENT, TYPE CG-55AEB.

Designed and produced by the General Electric Co., U.S.A., for installation in ships or shore stations. This Projection Type Plan Position Repeater performs a duty similar to the conventional P.P.I., except that the pattern is optically projected on to a large flat horizontal surface, instead of being observed directly on a cathode ray tube face. The complete unit is approximately the size of a desk, 35in. high, with the viewing screen occupying half of the top surface, and is operated as a plotting table, on which the actual map-in-motion is portrayed. Navigational calculations are made directly on the paper viewing screen, which can be replaced at will from the built-in 30 yard roll supply.

The full screen may be employed to map an area of 4, 10, 20, 80, or 200 mile radius, the choice of range being made by a range selector switch. Electronically generated range marks divide the screen into concentric rings for ranging purposes. In addition, two bearing scales are projected on to the screen, one being fixed to present true or relative bearing, the other rotating to present heading. The radar pattern is therefore far more significant, because it can be observed simultaneously with the pattern of actual bearing.

The equipment is designed for operation with any radar system, of repetition rates of from 60 to 1,000 per second, and only very limited arrangements are necessary to provide the video, trigger and synchro inputs.

**BRIEF TECHNICAL SPECIFICATION**

**Power requirements:** 115 v. A.C. Single phase, or 230 v. with auxiliary transformer. Total consumption 1765 watts.

**Input requirements:** Trigger voltage 5-40 volts peak. Video voltage 3 volts peak-max.

**Ambient Temperature Limits of Operation:** 0°C to +50°C.

**Screen Diameter:** 25¾in.

**Picture Diameter:** 24in.

**Image Visibility:** Image on Projection Screen may be observed in the presence of approx. 1 foot candle of indirect lighting.

**Optical System:** Highest grade components by Bausch & Lomb.

**Range Accuracy:** ±1% of total designated range.

**Bearing Accuracy:** Within .75 degrees.

**Overall Dimensions:** 59in. x 34in. x 35in.

**Weight unpacked:** 1,000 lb.

The exceptional quality of construction, together with the numerous operational advantages, are several of many features which make this advanced equipment of outstanding interest in the field of Radar Engineering.

**MODEL VE RADAR INDICATING EQUIPMENT, TYPE CAY-55ADV.** Manufactured by The Westinghouse Mfg. Co., U.S.A., for installation in ships or shore stations. A Plan Position Indicator Repeater of conventional type, employing a seven inch electro-magnetic cathode ray tube. Instrument is fully enclosed in console type housing.

**BRIEF TECHNICAL SPECIFICATION.**

**Power requirements:** 115 v. A.C. Single phase, or 230 v. with auxiliary transformer.

**Range Calibrations:** Electronic, with switched selection of ranges 4, 20, 80, 200 miles radius.

**Overall Dimensions:** 13in. x 24in. x 26in.

Full technical details of the above equipments available on request from:

**LAWRENCES, 61 BYROM ST., LIVERPOOL.3**

Phone CENtral 4430

# UNIVERSITY RADIO, LIMITED

## Offer Guaranteed Used Equipment at Attractive Prices

**AR88-LF** in perfect condition, complete with all valves. A.C. 110-230 v. ..... £37 10 0

**AR88-LF Chassis**, with all valves, in perfect condition. No cabinet £25 0 0

**R.M.E.69**, with Pre-selector and Speaker, perfect, and complete with all valves, etc. ..... £25 0 0

**2 only R208's.** Complete with all valves. Perfect ..... each £12 0 0

**BC348**, unconverted, perfect with all valves ..... £15 0 0

**As above**, converted to A.C. mains 200-250 v. ..... £15 0 0

**BC342**, converted to A.C. mains, 200-250 v. ..... £15 0 0

**Ex-W.D. U.S.A. SCR625 Mine Detectors**, complete less batteries. A few only each ..... £9 0 0

**Avo 1948 Model Battery All-wave Signal Generator**, as new, with batteries ..... £10 10 0

**As above**, case scratched, but good condition and working order ..... £8 0 0

**Avo Signal Generator**, as new. A.C. mains, 200-250 volts ..... £11 0 0

**Taylor Circuit Analyser**, Model 20A, as new ..... £11 0 0

**R.C.A. 'Scope**, in new condition. 110 volts, A.C. ..... £30 0 0

**Taylor A.C.-D.C. Test Meter Model 70A**, as new ..... £7 10 0

**Taylor A.C.-D.C. Test Meter, Model 90A**, as new ..... £10 0 0

**Taylor A.C.-D.C. Valve Tester, Model 45A**, as new ..... £14 0 0

**Taylor A.C.-D.C. Valve Tester, Model 47AP**, as new ..... £18 10 0

**Avo 7's**, in perfect working order. As new ..... £13 0 0
(Leather cases £2 extra).

**Hunt's Capacity and Resistance Bridge**, model CRB. As new £11 0 0

**1948 9 Model Charles Amplifier** in perfect condition. Complete with all valves ..... £10 0 0

**Plessey Record-Changer**, listed £14/10/-. Our Price ..... £9 10 0

**Roger's Development Co. Junior Amplifier**, cost £19/19/-, complete with all valves. Also Radio Feeder Unit, which cost £9/10/-. Both items as new. Our price for the pair ..... £17 10 0

**Collaro flsr Type Mixer-changers**, As new ..... £12 0 0

**Vitavox Pressure Unit**, 20 watt type G.P.1. As new ..... £6 0 0

**E.D.C. & Ward Rotary Convertor**, 200-250 volt D.C. 230 A.C., 50 cycle. In cabinet with Filter Unit. 120 watts ..... £10 10 0

**As above**, 250 watts ..... £14 0 0

**As above**, 300 watts ..... £15 0 0

**Auto-transformers**,. Ex-W.D. U.S.A. 115 to 230, 50 cycle 2.2 kVa £5 5 0

**Transformer 200-250 volts A.C.** 6/9/12 volt, 90 amp. A first class job ..... £4 10 0

**GB-LS16 16 mm. Silent or Sound on Film Projector**, A.C./D.C. 110 volt. Less speaker and step down resistance. Almost new ..... £75 0 0

**Another GB-LS16**, complete and perfect in every detail, with 8ft. 6in. screen. Absolutely ready to use. ..... £89 10 0

**S.T.C. Ball Mikes. Type 4021C.** High quality Recording mikes. Used by all the leading recording studios. As new, each ..... £5 5 0

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**Taylor 65B Signal Generator**, as new ..... £11 10 0

**1948 B.P.L. All-wave Signal Generator.** As new ..... £10 10 0

**Advance E-1 Signal Generator**, as new ..... £15 0 0

**Ex-W.D. Marconi U.H.F. Signal Generator**, type TF517E, with Power-pack. In perfect condition and working-order ..... £25 0 0

**Ex-W.D. U.S.A. Bendix U.H.F. Signal Generator**, type 1/130/A As new with all leads, etc. ..... £18 10 0

**WE HAVE OTHER TYPES ARRIVING DAILY FROM £6.**

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**Others**, less cases (500 volt) ..... £6 10 0

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**Evershed's 100 volt Wee Megger and Megger Ohm-meter**, in leather case. As new £7 10 0

**Evershed's 500 volt Bridge Megger** in leather case. Cost £48. Our price, in new condition ..... £20 0 0

**As above**, in perfect working order, but case slightly soiled £15 0 0

**Evershed's 500 volt Meggers**, in aluminium case ..... £11 0 0

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**Brand new Descaphone inter-comm. set.** Master Unit with four extensions. Cost £27/10/-. Complete with all valves, etc., A.C. and D.C., 200-250 volts. ... £13 10 0

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**Pam 25 watt Amplifier**, complete with 2 Pam Speakers and Pam Gramo' Player unit. In perfect working order. The lot £31 0 0

**H.M.V. 10 watt 'gram Amplifier** in metal case, one only, in perfect working order. A.C. 200-250 volts. A real bargain ..... £10 10 0

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**Vitavox 10 Watt Pressure Unit** type B. Perfect ..... £3 10 0

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**Weston E772**, 20,000 O.P.V. A.C./D.C. Test Meter in portable case. As new ..... £15 10 0

**As above**, 1,000 O.P.V. ..... £12 0 0

**C.D.P. Recording Units**, less Amplifier. As new ..... £23 0 0

**Collaro AC/DC 'Gram Unit**, motor and turntable. As new ... £6 10 0

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**Cossor Ganging Oscillator** model 3343 with Data Book. In perfect condition ..... £10 0 0

**A SPECIAL BARGAIN !! Bell & Howell (U.S.A.) 16 mm. Sound on Film Projectors**, complete and portable, with all parts, valves, speaker, cables lens, etc., less step-down transformer. Believed in working order, but we cannot guarantee them so. We are prepared to exchange any faulty part. We consider these a genuine bargain. **£57 10s. 0d. each.**

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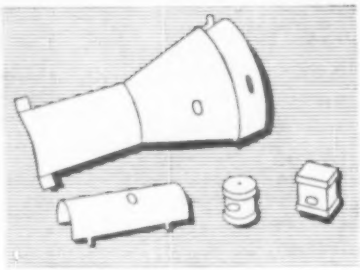

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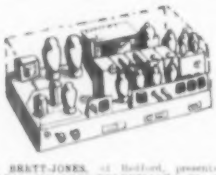
TELCON



# RADIO EXCHANGE CO.



J. C. BRETT-JONES, of Bedford, presents the WORLD'S CHEAPEST TELEVISION! The S.L.C. receiver, with two R.F.s, four I.F.s, and all ancillary circuits, PLUS additional stages which will convert for Time Bases, is the ideal foundation unit, and with the addition of a mains transformer, VCR97, four condensers, three pots, one resistor and two 3ffs, can be converted into a self-contained cathode receiver for approximately £6. The receiver only, 30/-, carriage paid. Conversion data, 3/- per copy.

**RECEIVER TYPE 21.** The ex-Army receivers, with six VP23s and three HL23DDs, function as a superhet from 4.3—7.5 mcs. and as a double superhet from 18-31 mcs. They require 120/150 v. H.T. and 6 v. L.T. Removal of filament dropping resistors will enable the set to be used with a 2 v. accumulator. Complete with circuit, 35/-.

**W.S21. POWER UNIT.** A small vibrator pack, designed for use with the Wireless Set 21, and operating from a 6 v. input. The 6 v. filament circuit of the receiver enables a small, complete unit to be fitted into one cabinet . . . ONLY 18/6.

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**MOVING COIL UNITS** . . . separate moving coil headphone units, complete in bakelite cases, which may be used as midget speakers, microphones, etc., 45 ohms impedance, and made by various famous makers. TO CLEAR 2/- each.
Balanced armature headphones, approx. 150 ohms, complete with headbands. 2/6 pair.

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**I.F.F. TRANS-RECEIVERS.** One of the best known surplus units . . . can be converted for 144 mcs or will provide a goldmine of parts. Complete with 32 mains operated (6.3 v.) valves, and a 9 v. motor generator which can be converted into a mains motor. OUR PRICE, with mains motor conversion data, 22/6.

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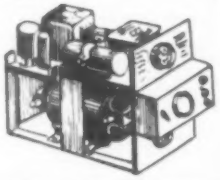
**NOISE LIMITER KITS.** A complete sub-assembly, with all small parts ready to fit in your chassis. The instruction booklet, referring to a U.S.A.F. receiver, is sufficiently comprehensive to enable the unit to be fitted in ANY superhet. Price 3/6.

**POWER UNIT TYPE 19.** Used with the famous W.S.19, this unit consists of a motor generator delivering 240 v. at 40 mA., and 275 v. at 110 mA., PLUS a vibrator pack (OZ4 rectifier) delivering 275 v. Input is 12 or 24 v., and outputs are fully smoothed. TO CLEAR, 12/6.



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All goods sold as used unless otherwise stated.

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**Bargains in Ex-Services Radio and Electronic Equipment**

**In Maker's Original Packing.**

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American version of the No. 18 Set, modified to U.S. Army requirements.
Frequency coverage, 6 to 9 mc/s—33.3 to 50 metres.
Complete equipment for "Phone" and C.W. comprising :—

**TRANSMITTER,** with 1000 kc. Xcal, 5 valves, 1A5, 2/1299s, 2/1LD5s, etc.

**RECEIVER,** with 6 valves, 4/1LD5s, W1L6, 1A5, etc., etc.

**HAND DRIVEN GENERATOR,** supplying H.T. and L.T. plus 12v. bias (when switches for WS18) with operators seat, etc.
**AERIAL,** 10ft. Rod type (11 sections) range 5 miles R.T. 10 miles C.W. greater ranges can be obtained with a normal aerial.
Plus, cables and **INSTRUCTION BOOK.**
This equipment can also be used with dry batteries (not supplied) as a **PORTABLE WALKIE-TALKIE.**
Power requirements H.T. 162v. 60 m/a. L.T. 3-1V. 0-3A.
Dimensions : Set and battery container : 11½ x 10½ x 17½ in.

**CLYDESDALE'S PRICE ONLY £14 10 0** CARRIAGE PAID

**LABORATORY RESISTOR ASSEMBLY R369.**
H.175, 330,000 ohm resistors, 5 watt to withstand 5,000 volts. 2in. dia. Can be mounted with ceramic ins., price **10/6**, post paid.

**VALVE RETAINING CLAMP.**
H.71, snap action, price **1/-**, post paid.

**STRIP RESISTORS, H.174.**
10 ohm 35 watts. 8in. long, ⅞in. wide, with fixing flange. Price **1/-**, post paid.

**BENDIX MI-4A AMPLIFIER.**
Two valve, two stage audio amplifier with built-in 24 volt vibrapack, 12SJ7, 25L6, fully smoothed, complete with transformers, etc., in metal case 13 x 8½ x 3½ in.

**CLYDESDALE'S PRICE ONLY 35/- each.** POST PAID

Units of the SCR-522 (TR5043) for experiments on 3 meters T.V. and Radio Telephone wavebands.
**BC-624-A Receiver Unit Chassis.**
Frequency 100-156mc/s with 11 valves, complete chassis (less Xtals) with I.F.T.s Relay, etc. Power requirements (external) H.T. 300v. D.C. 75 m/a. L.T. 24v. D.C. 3A. Dimensions : 15½ x 7½ x 6 in.
Circuit supplied.
PLUS, Free Gift **BC-625-A Transmitter Unit Chassis,** partly stripped, but containing many useful parts, R.F. section in good order, no valves, modulation trans. or Xtal switch. Dimensions as receiver.

**CLYDESDALE'S PRICE ONLY 37 6** CARRIAGE PAID

Circuits for Ex-Services Equipment available, full list on application.

**CO-AXIAL CABLE, ANY LENGTH SUPPLIED.**
12 mm. 52 ohms solid core at **6d.** per yard. Minimum 20 yards, **10/-**, post paid.
12 mm. 80 ohms Airspaced core at **9d.** per yard, minimum 20 yards **15/-**, post paid.
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**H.V. INSULATED VALVE TOP CONNECTOR.**
E.156 moulded in red bakelite with side entry for 4 mm. cable, to suit standard valve top 9 mm.

**CLYDESDALE'S PRICE ONLY 9D.** each POST PAID

**SUPPLY UNIT RECTIFIER FOR CANADIAN ARMY No. 43 TRANSMITTER.**
This unit is a complete power unit for use with 110v. A.C. 50 cycle input. The outputs are various.
Components include : Transformers H.T. 2100-0-2100, tapped 500-0-500. L.T. 2.5 C.T. twice for 866s 450-0-450. 12v. C.T. volts, 6.3v. C.T. volts, 6.3 volts, 5 volts, Thermal starter 6.3 volts. Chokes 2/15H. 375 m.a. 120 ohm 15H 450 m.a. 66 ohm 20H 162 m.a. 160 ohm 2/15H 110 m/a. 260 ohm H.V. Condensers. Valves : 4/866A/866, 5Z3. LV Starter. VR150/30, 6SJ7, 2/6A3. Regulator circuit. Dimensions : 2ft 6in. x 1ft. 6in. x 1ft. with shock absorbing feed. Weight 420 lb. In metal case, finished in drab olive crackle, with O.P. and L.P. sockets, switches.

**CLYDESDALE'S PRICE ONLY £16** each CARRIAGE PAID

**In Maker's Original Packing.**
**R.F. UNIT TYPE 24.**
For 30-20 mc/s, 10-15 metres.
Switched tuning 5 pre-tuned spot freq. 3/VR65 (SP61) output approx. 7-8 mc/s in metal case 9½ x 7½ x 4½ in.

**CLYDESDALE'S PRICE ONLY 19 6** each POST PAID

Used, good condition at **12/6**, post paid.

**NOW READY.**
New Illustrated List No. 6 (152 pages), send 6d. to cover distribution cost. Please print name and address.

**MAINS TRANSFORMERS.**
E.542, ideal for R1355 receiver.
Pri., 0-250v. Tapped 200, 220, 240v.
Sec., 350-0-350 volts, 100 m/a.
Capable of delivering up to 150 m/a. with slight temperature rise.
6.3v. 6A. 5v. 2.5A.
Size : 4½ x 4½ x 4 in. Weight 12 lb.

**CLYDESDALE'S PRICE ONLY 30/-** CARRIAGE PAID

**EHT TRANSFORMER, E.531.**
Ideal for VCR-97.
Pri., 0-250v. Tapped 200, 220, 240v.
Sec., 2,000 volts, 5 m/a.
4v. 1.1. amps.
2-0-2v. 1 amp.
Upright mtg. Dimensions : 3½ x 3½ x 3 in.

**CLYDESDALE'S PRICE ONLY 29 6** POST PAID

**Brand New**
**E.534 MODULATION TRANSFORMER.**
Thermador potted type (U.S.A. made) with ceramic stand of terminals. Pri. 6,700 ohms C.T. Sec., 4,500, 5,000 and 5,500 ohms max. op. 470 freq.—10db. 400-4,000 c/s. Test 5,000v. suits TZ40, T35, 813, etc. Size : 7 x 6½ x 5½ in. Weight 22 lb.

**CLYDESDALE'S PRICE ONLY 42 6** each CARRIAGE PAID

**R.C.A. DRIVER TRANSFORMER (110K 117) XT. 3202.**
E.562 C.T. Primary : Inductance 3.4 henries.
2 Secondaries : Inductance 14 henries each.
Ratio : whole pri. to one sec. 1 : 2 approx.
Dimensions : Ht. 4½ x 3½ x 3½ in. Weight 6½ lb. 4-hole fixing.

**CLYDESDALE'S PRICE ONLY 15/-** each POST PAID

**Brand New.**
**HIGH VOLTAGE ROTARY TRANSFORMER (by Hoover).**
Type HT32. Input 11.5 volts D.C. Output 490 volts, 65 m/a.
Dimensions : 5½ in. long x 3in. dia. cylindrical.

**CLYDESDALE'S PRICE ONLY 25/-** each POST PAID

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| R1481 V.H.F. Receiver Unit at | 99 | 6 |
| A.C. Power Unit type 3 at | 79 | 6 |
| Or both above items at | £8 | 8 0 |
| Master Oscillator type MI-19467-A at | 79 | 6 |
| Crystal Multiplier type MI-19468 at | 39 | 6 |
| R-28/ARC-5 100-150 m/c. Receiver Unit at | 37 | 6 |
| BC-733-D Receiver Unit at | 30 | 0 |
| Bridge Megger 100 megs. at 1,000v. at | £35 | 0 0 |
| Wee Megger 20 megs. at 250v. at | £5 | 19 6 |
| Power Unit 247 at | 59 | 6 |
| Battery Amplifier A.1368 at | 11 | 6 |
| SCR-720 Blower, with shunt motor at | 17 | 6 |
| Reflector Aerial (MX-137/A) at | 5 | 6 |

As previously advertised, price includes carriage.

**MOVING-COIL MIC HEAD-PHONE ASSEMBLY**

Comprising moving coil microphone (Hand No. 7) with pair of M.C. Headphones and 3ft. lead with rubber 5 point socket. Imp. approx. 60 ohms per insert.

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Phone : South 2706/9. Visit our Branches in Scotland, England and Northern Ireland.

## Announcing the £15 T/V for the Midlands

Constructors in the Midland TV Area will be pleased to learn that the Data for our Mk. II Televisor for operation on the Sutton Coldfield Frequencies is now available. All constructors of this Televisor who have not yet received the information should write in quoting date of purchase and invoice number, when the full details will be supplied gratis.

This Televisor, many hundreds of which are in service, is designed round two Radar Units which cost only **£6** the pair. One unit is an Indicator containing a VCR97 C.R. Tube, and the majority of the valves and components, and the other unit is a ready made Vision Receiver which only requires modification for the TV Frequencies. Use of this latter item, which was made regardless of cost to a planned layout, eliminates many of the headaches experienced by those who have attempted the construction of a Vision Receiver from scratch. The Constructional Data is most detailed, with photographs, parts lists, circuit diagrams, etc., and costs only **7/6**, or is supplied gratis with the two Radar Units. Alternatively, it may be purchased, and the cost will be credited against the subsequent purchase of the Radar Units within 14 days. A fully detailed price list shows that the total cost is **£15/4/9.** Please note that orders for the Radar Units should include an additional **12/6** carriage costs, plus 10/- deposit on packing case.

For Constructors embarking on other circuits we can supply a wide range of component parts, many of which are listed below :—

**RECEIVERS R1355.** As specified for "Inexpensive Television." Complete with all valves, and a copy of the booklet (which can be supplied for 1/9). ONLY **45/-** (carriage, etc., 7/6).

**RF UNITS TYPE 25** specified for London Area Station, **17/6** (postage 1/6), OR R1355 RECEIVER AND RF UNIT 25, **62/6** (carriage 7/6).

**RF UNITS TYPE 26,** specified for the Birmingham Station are now all sold, but we can supply the RF Unit 27 with full details of modification to cover the TV Frequencies, simply by retrimming. ONLY **35/-** (postage 1/6), OR R1355 RECEIVER AND RF UNIT 27 FOR **75/-** (car. 7/6).

**INDICATOR UNITS TYPE 6.** The indicator unit specified for "Inexpensive Television," this being complete with the VCR97 Tube and valves. BRAND NEW IN MAKERS CRATES. ONLY **90/-** (carriage 7/6).

**TRANSFORMERS** for above TV have been specially made as follows : Time Bases and Vision Transformer, 350-0-350v. 160 m/a, 5v. 3a., 6.3v. 6a., 6.3v. 3., ONLY **16/-.** Sound Receiver Transformer, 250-0-250v. 100m/a, 5v. 3a., 6.3v. 6a., ONLY **27/6.** EHT Transformer for VCR97 Tube, 2-0-2v. 1.1a., 2-0-2v. 2a., EHT at 5m/a.

**MAGNIFYING LENS** for 6in. C.R. Tube. Brings up the picture size to approximately that given by a 9in. tube. ONLY **25/-** (postage 1/6).

**SMOOTHING CHOKES.** 10H. 80 m/a., **8/6**, 3H. 200 m/a., **6/-** (postage on each 9d.).

**EHT CONDENSERS.** 2,500v. .1 mfd oil filled tubulars, **2/6** (post 3d.), 3,000v. .1 mfd block paper size $3\frac{1}{2} \times 2\frac{1}{2} \times 3\frac{1}{8}$in (inc. terminals), **4/6** (post 9d.).

**CO-AXIAL CABLE,** 75-80 ohms, **1/3** per yard.

**PYE CO-AXIAL** plug and socket, **1/-** pair or **6d.** each.

**SPEAKERS.** 10in. Truvox PM less transformer, **17/6** (postage, etc., 2/6).

**CONDENSERS.** 2 pf to .1 mfd, mica, silver mica, or paper **6d.** each.

**RESISTORS.** ¼w. **4d.**, ½w. **5d.**, 1w. **6d.**, 2w. **9d.**

CWO please. Add postage where not stated on orders under £2.

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# TELEVISION
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**OUR Kit of Parts** (down to the last nut and bolt) is proving doubly popular because (a) the price of **£16 19s. 6d.** is amazingly low, and (b) the explicit nature of our instructions and easy to follow point-to-point wiring diagrams **ensures success for all.** Its most convincing feature, however, is that the conversion of ex-government equipment is NOT involved.

**The Televisor** is built from standard radio components and assembled on two chassis, one for the Vision Receiver, Sound Receiver and Time Base, the other for the Power Supplies. It operates on A.C. Mains 200-250 volts.

If price is the cardinal consideration we can supply the **Complete Kit** for only **£15.** The valves and C.R.T. are slightly used but guaranteed perfect in this case. The carriage charge on either Kit is 10s.

Price of the comprehensive point-to-point wiring diagrams and 17 pages of data is **5s.** post free. May we urge you to send for these initially. If a Kit is subsequently purchased the **5s.** will, of course, be credited. PLEASE SPECIFY LONDON OR SUTTON COLDFIELD WHEN ORDERING THIS DATA.

### *NOTE THESE ★ FEATURES*

★ NO knowledge of television technique essential.
★ ALL parts complete, brand new, and of the finest quality.
★ ALL parts may be purchased separately.
★ ROCK-STEADY picture assured because six EF50 valves are used in the Time Base and Synch. Separator.
★ UNIQUE "After-Sales" Service. Testing and alignment of receivers after completion of assembly undertaken for a nominal sum. WE GUARANTEE RESULTS.

Our Televisor is equal to many commercial models. Why not come along and see a demonstration during viewing hours ?

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**AMERICAN TRANSCEIVERS TYPE 48,** frequency coverage 6-9 Mcs. We proudly offer the complete station which is all brand new and packed in 6 cartons, comprising the following items : 1 Transmitter/Receiver type 48 ("walkie-talkie") complete in case and complete with 10 valves and one 1 megacycle crystal; 2 satchels 1 ground aerial, spare valve case complete with 10 spare valves, 1 key assembly, 1 hand microphone, 2 headsets, 1 hand generator, together with mounting tripod, 2 battery boxes and all necessary interconnecting cables, and a comprehensive Instruction Manual. *Only* **£13 19s. 6d.** *carriage paid, while they last.*

**Indicating Unit Type 230.** This unit works from A.C. Mains 110 or 230 v. 50 cycles. Contains a mains transformer giving 350-0-350 80 mA, two 6.3 windings, one 5 v. 2 amp. and the following valves : 1 5Z4, 1 Y63, 1 EA50, 4 EF50. Housed in metal case and in good condition. Made by G.E.C. *Only* **39s. 6d.,** plus 3s. 6d. *carriage and packing.*

**Receiver Unit 25/73.** Good news. Another large purchase enables us to offer these exceptionally popular units at **22s. 6d.** post free. Valve line-up : 2 EF39, 1 EK32, 1 EBC33 and 2 EF36 ; and one pair of 460 Kcs IF Transformers, resistors, condensers, etc. Easily and rapidly converted to an ordinary superhet receiver. Circuits and conversion data supplied. *Order early.*

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**Receiver R1155A.** BRAND NEW, UNUSED and IN TRANSIT CASES. First come first served! The R1155A is justifiably the most renowned and popular of communication receivers. Our price of **£11 19s. 6d.** carriage paid to your door brings this superlative receiver to you at a modest price. We repeat : absolutely brand new and in magnificent condition.

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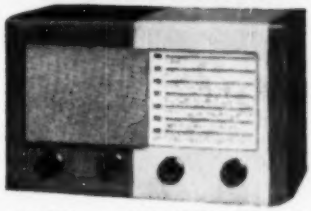

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Medium: 1550 to 526 Kc/s (193 to 570 metres).
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31 metre band (9.90 to 9.40 Mc/s).
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*Brand new R1155A Receivers in transit cases*

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(*Carr. & Pkg.* 10/-)

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**For a limited period we are offering the already famous BURGOYNE INSTANT HEAT SOLDERING GUN (advertised and sold by the makers at 79/6) FOR ONLY 52/6**

We are setting a standard for value which you will find hard to beat. This offer has been possible only by an ACCIDENT—a blocked export shipment that missed the last boat to South Africa!

**SAVE TIME ON SOLDERING!**

Just press the button, count seven, and solder and the bit will remain at soldering heat until you release the pressure, when it cools off instantly.

No waiting to warm up or cool down—no element to burn out—no mica to crack or splinter—no risk of shock.

Few tools possess so many advantages as the "Seven-Second" Solder Gun; and certainly no engineer can consider himself up to date without one. For A.C. mains, 200-250v.

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We can now supply the famous U.S.A. made 2 volt Vibrator Power Supply as used on the Canadian Type 58 Walkie-Talkie. BRAND NEW and complete with Vibrator. Add carr. and pkg. 2/6.

*Specification:*—

2v. input, 90v. or 180v. 35 m/a, 1.5 v. L.T. outputs.

Size 8 × 3½ × 4½in. Charging circuit for Accumulators supplied. Also available complete with two 2v. Accumulators in case for 50/-. (*Carr. and pkg.* 5/-).

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A brand new full size 5 valve superhet made for the export market (110v. A.C.). The Receiver is housed in a handsome light walnut cabinet with built-in speaker. Frequency coverage 13-46, 46-150, 190-560 metres. The Receiver is fully tropicalised and most of them are in wooden transit cases.

Full maker's service guarantee. An unrepeatable offer for only **£15** including tax. (*Carr. and pkg.* 10/-.)

We give away with each of these fine Receivers an Auto Transformer to convert the mains voltage input for use on all A.C. mains (voltages 110-250). ONLY A LIMITED QUANTITY AVAILABLE.

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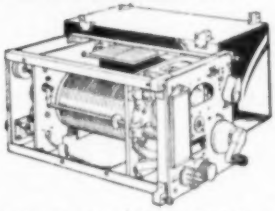

Provide correct impedance matching for your Receiver or Transmitter for any length of aerial. This BRAND NEW tuning unit will give you greatly increased signal strength over a frequency coverage of 2.4 to 13 m/cs. The unit is a compact assembly comprising rotating coil assembly with pulley arrangement to operate the revolution counter. An 0-3 ammeter is mounted on the front panel together with the tuning handle for the coil. This handle may be locked in any desired position. Size of the unit 5 × 5 × 9in. Each one fitted in original wooden transit case. PRICE **13/11** (*Post and packing* 1/1).

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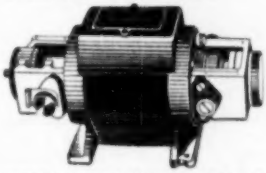

A universal Purpose Motor Generator fully guaranteed, brand new and in original maker's cartons.

This unit can be driven from D.C. voltages from 2v. to 14v. and will give varying outputs according to the input voltage. For example: At 6v. D.C. input an output of about 230v. 30 m/a will be obtained.

At 4v. D.C. input, 180v. 25 m/a will be obtained.

At 12 v. D.C. input, 480v. 40 m/a will be obtained.

The motor will also provide sufficient power for use as a grinder, polisher, etc., as a spindle protrudes 1in. from the casing of sufficient length for mounting these. Approximate R.P.M. at 12v. D.C. input, is 2,000 (varying according to the applied voltage.)

The cost of manufacturing these useful equipments was approximately £8 to £9. (*Post and pkg.* 1/1). OUR PRICE **8/11**

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¼ Meg. Volume Controls with Double Pole Switch Spindle 1in. Small overall diameter 1¼in. **3 for 12/6**

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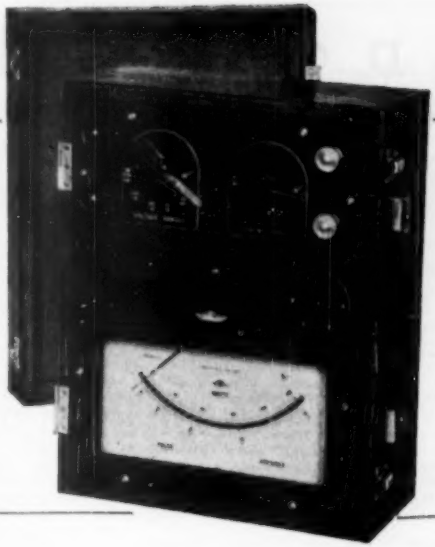

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Entirely self-contained in polished hardwood case with carrying handle and removable lid, as shown.

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**CONSTRUCTOR'S PARCEL** comprising chassis 10½in. x 5½in. x 2in., with speaker and V.H. cut-outs, Rola 5in. P.M. with trans. twin gang with trimmers, pair of T.R.F. coils, 4 valve holders, **17/6**, plus 1/6 Post and Packing.

**P.M. SPEAKERS.** All by leading manufacturers. Less transformer. 6in. **8/9**, 8in. **11/9**, 10in. **14/6**, 12in. **29/6**. With transformer 5,000 ohm impedance. 5in. **11/-**, 6in. **11/-**, 8in. **14/-**, 12in. **31/9**. All plus 1/- P. & P.

**ELECTROLYTIC CONDENSERS.** All by good manufacturers. 2 mfd. 350 **9d.**, 16 x 24 mfd. 350 **2/11**, 16 x 16 mfd. 450 **3/6**, 8 x 8 mfd. 450 **3/6**, 8 x 16 mfd. 450 **3/6**, 8 mfd. 450 **1/11**, 12 x 12 mfd. 450 **2/9**, 32 x 32 mfd. 450 **5/6**, 24 x 24 mfd. 200 work **1/3**, 500 mfd. 6 v. **1/3**, 250 mfd. 12 v. **1/3**, 50 mfd. 50 v. **1/9**, 50 mfd. 12 v. **1/-**, 25 mfd. 25 v. **1/-**.

**VOLUME CONTROLS**, with switch, long spindle, ¼ meg. **3/10**
1 meg. **3/6**, .35 meg. **2/9**, 25 k. **3/-**, 50 k. **3/-**.

**VOLUME CONTROLS**, less switch, long spindle, 1 meg. miniature **1/6**, 5 k. **1/9**, 50 k. **1/6**, 20 ohm wire wound miniature **2/6**.

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**.0005 TWIN GANG, 3/6.** Post 6d.

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**MINIATURE TWO GANG,** .00037, **6/-**.

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**TWIN TRACKERS.** 100 and 500 pf. **9d.**, 100 and 200 pf. **9d.**, 300 and 300 **9d.**

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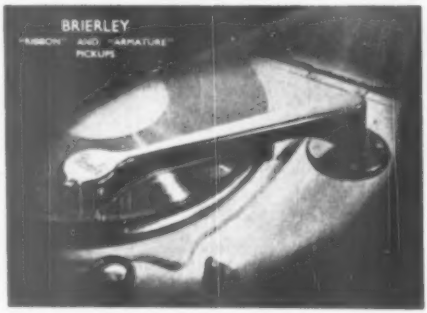


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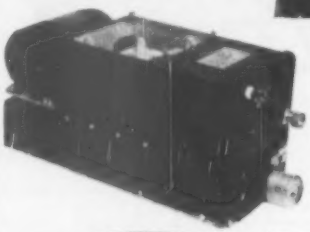

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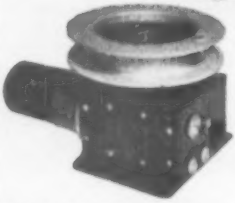

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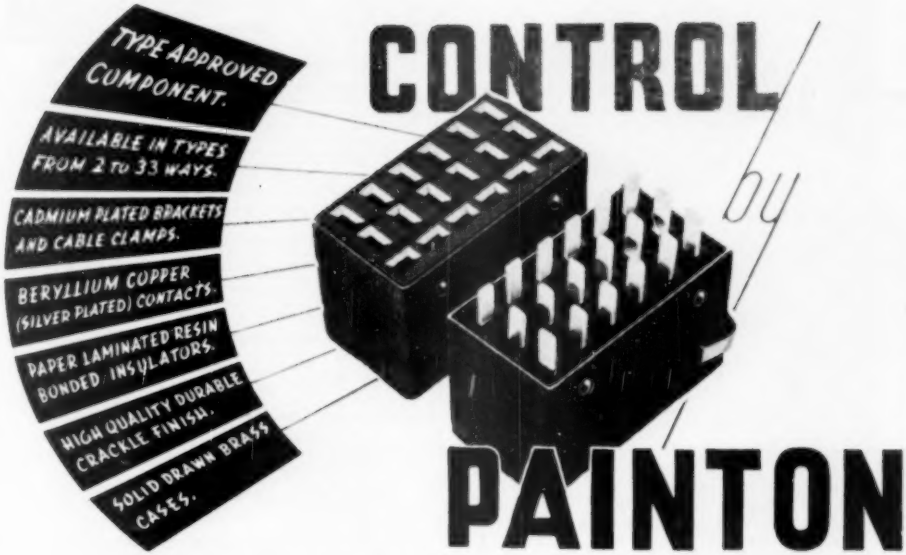


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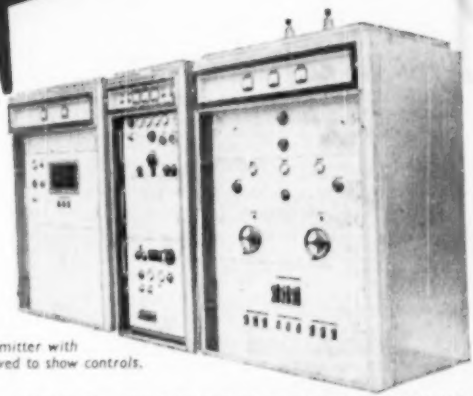

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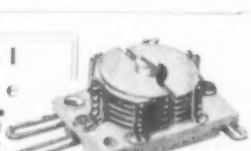

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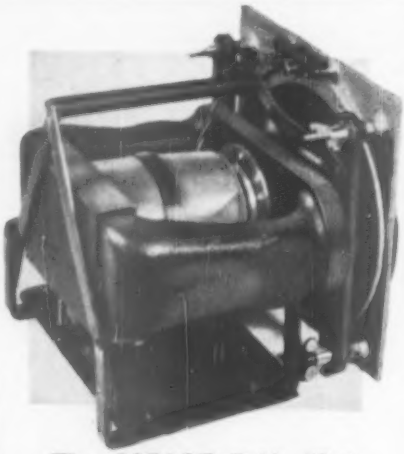

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(As reviewed "W.W." March 1949, Page 103).

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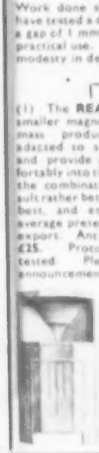

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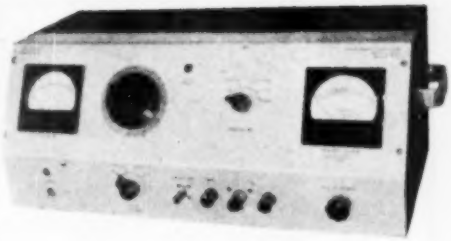

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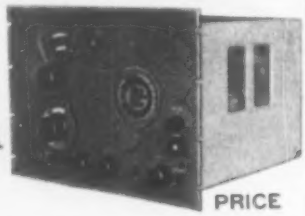

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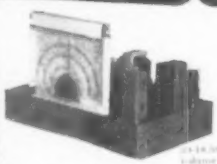

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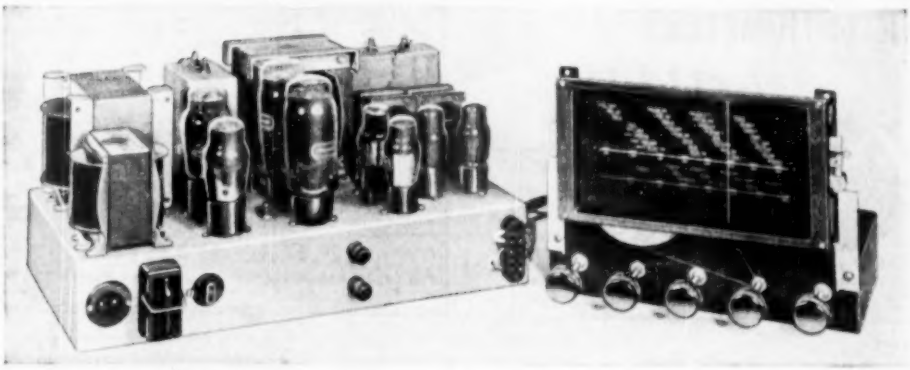

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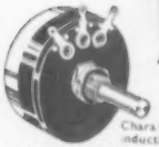

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ILLUSTRATED catalogue, price 9d. full details of Denco and Eddystone range; tuning units, television kits and surplus radio bargains. [4578

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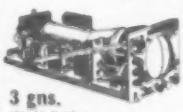

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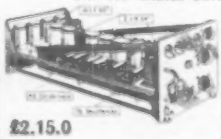

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WARD rotary converter, special smoothing filter equipment, soundproof box absolutely as new, 110volt d.c. input, 230 a.c. output 500watts; £25.
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PETROL and T.V.O. charging and lighting sets, 12volt; no a.c. plants at moment; new Dough as 54kw oil engines, air-cooled, complete on stand, £30 and carr.; J.A.P. engine, No. 2a, 1.25h.p. air-cooled, new, £15, delivered; 14-32v 250watt with or without control o.x. 6v 85amp-hour batteries, unused, £5/10, delivered; inquirers kindly state exactly what you are interested in, see advt. under Components for S.T.C. rectifiers.
PEARCE, 66, Gt. Percy St., London, W.C.1. [0014

### NEW TEST EQUIPMENT

BATTERY chargers, 6-12-24v. 1-amp. enclosed steel case with ammeter, a.c. mains operated, 42/6.—Thames Valley Products (W), 24, Camden Ave., Feltham. [4264

DID you see the new Amplion test-meter at Radiolympia? A.C., D.C. and ohms, 1,800 o.p.v., 10 ranges, handy pocket size, for 67/6 (post 1/-), 5,000v test prod., 9/6 extra; this is a high-class, accurate moving-coil instrument.—Westmead Radio, 117, Westmead Rd., Sutton, Surrey. [4615

17 range a.c.-d.c. multimeter, small size, movement 200μa d.c. ranges, a.c. d.c. volts 10, 50, 100, 500, 1,000v at 4,500Ω per volt, d.c. current 1, 10, 100, 500ma, resistance 0-5kΩ, 0-500kΩ, 0-5mΩ, all self-contained, fully guaranteed, £5/10, complete with leads and test prods; send for illustrated leaflet.
C. & W. ELECTRONICS, 15, Oswald Rd., Oswestry, Salop. [4878

OSCILLOSCOPE and Wobbulator complete, £20; T.B. 5/5 10 to 350,000 c.p.s. X and Y plate amplifiers, easy to handle, has outstanding performance, fully guaranteed, immediate delivery with set of leads and booklet "Oscilloscope Technique"; further details from the manufacturers.—Erskine Laboratories, Ltd., Scalby, Scarborough. [5456

### TEST EQUIPMENT—SURPLUS AND SECONDHAND

BPL RS 600 signal generator, very good condition, Taylor 75A multirange meter, one year old; also unused Avo valve Tester available.—Apply, Box 1464. [4845

VARIACS, type 100L, input 230v, 1-ph, 50kps, output 0 to 250v, 8amps, £12 each; type 100L-5G, input 400v 3-ph, 50cps, output 0 to 300v, 5-ph, 6kva, £36 each; all as new and perfect.
F. B. CRAWSHAW, 166, Pixmore Way, Letchworth, Herts. [4888

AVO Minor in case, £3/17/6; Avo valve tester, £8/10; Avo sig. gen., a.c., £10; Avo auto sw. Xtal pick-up, 50/-; Rothi sen. Xtal p.u., £2.—J. Law, A.M.I.R.E., 21, Linton Ave., Penn, Wolverhampton. [4879

MARCONI Sig. Gens., TF 144G, TF 590, TF 517s, output meters TF 540, Taylor ditto, 140A, Cossor ranging oscillator 745, BC 221, p.p. as new, enquiries invited; also large quantities components, etc.; send stamp for lists.—R.T. & I. Service, 254, Grove Green Rd., London, E.11. Lev. 4986. [0056

### TRANSMITTING EQUIPMENT

TR9 transmitter-receivers, these were formerly sold at £6 each, the remaining few to be offered at £4/10/- carriage paid.
THE STAMFORD RADIO Co., 199, Stamford St., Ashton-under-Lyme, Lancs. [4795

HALLICRAFTER transmitters, Type HT4E (BC610) complete to makers latest specification, covering all frequencies from 1mc to 30mcs, complete with speech amplifier, connecting cables, etc., limited quantities only now available.
PANORAMIC adaptor, Type MCA44, British-made, suitable fitment to any good-class communication receiver, in addition to all Hallicrafter models, immediate delivery.
BRITISH-MADE under Hallicrafter licence, SX42 receiver, now available for export only.
McELROY-ADAMS MFG. GROUP, LTD., 46, Greyhound Rd., London, W.6. Tel. Fulham 1802. Cables Hallicraft, London. [4114

### NEW GRAMOPHONE AND SOUND EQUIPMENT

VOIGT twin unit, £12; rectifier, 50/-; 2ft horn, 30/-; 4ft horn, 60/-.—Vernon Cinema, Tarporley, Cheshire. [4818

MAGNETIC ¼in TAPE recording heads, standard model record-playback with split winding for bias and 5 or 1361 audio, 30/- each, erasing heads 30/- each.
HI-FIDELITY ¼in tape heads, circular Mumetal lam nations stacked ¼in, fully screened single unit (record-play), £4/10, 5in unit with tape lifting (record-play and erase), £9, full assembly (record, play, erase) with tape lifting, £14; impedance 5 or 15Ω to order, bias winding for TR7 use, set erase ¼in Ermtape, 1,000ft, £4/10; osc. coils, 15/-; circuits supplied free. Trade enquiries invited.—Morecambe Sound Service, 4-6, Green St., Morecambe. Tel. 1161. [0078

INFINITE baffle corner deflectors, scientifically designed acoustic chambers for 8 to 15in speakers, lists.—Broadcast & Acoustic Equipment Co., Ltd., Tombland, Norwich. [0064

WEARITE tape recording decks, £25; M.S.S. recording machines, blank discs, etc., processing your own masters, 52/6 per side; microphones, magnetic tape amplifiers, etc., full trade terms, immediate delivery.—Sound Discs (Supplies), Ltd., 179, Bispham Rd., Southport, Lancs. [4801

### NEW GRAMOPHONE AND SOUND EQUIPMENT

WEBSTER wire recorder, model 80, offered by maker to 110-250v 50cycles, modulation level indicator, crystal mike, new Sept. and hardly used. £Ofers or £85.—Box 1465. [4842

TAPE recording wire recording, for the finest components, service and satisfaction, record heads, coils, tape or motors, at prices that satisfy.—E. & M. Developments, 9, Troy Grove, Wyche Ave., Kings Heath, B'ham, 14. [4884

NEW super Collaro RC49 a.c. mixed auto-changer, in black and chrome, with hi-fi crystal pick-up, repeat, reject mech., price £14.6.8, carr. paid; the Collaro AC47 centre-drive gram. motor, non-magnetic turntable, ideal for moving-coil pick-ups, etc., variable speed, £5/18/6, carr. paid; Co.laro AC504 gramophone unit, motor, pick-up (latest magnetic type), and autostop, fixed speed 78 r.p.m., 10in turntable, £3/3/2, carr. paid; the Marconi AC100 auto-changer, plays 10 records, 10 or 12in (not mixed) fitted high fidelity lightweight pick-up, price complete with pick-up transformer, £10/10/6, carr. paid; N.R.S. de luxe microgram, comprising Collaro AC504 unit, 4-watt amplifier and twin speakers, in textile covered portable table cabinet, 17in×15in×9in, £15/10, carr. paid, cabinet only, £2; terms, c.w.o. or c.o.d.; W.W. list 2½d.—Northern Radio Services, 16, King's College Rd., Swiss Cottage, London, N.W.3. Primrose 8514. [0004

### GRAMOPHONE AND SOUND EQUIPMENT —SURPLUS AND SECONDHAND

WIRE recorder, new condition, from W.S.A., with amplifier and speaker, any examination invited; £37/10 complete.—8, Troy Grove, Wyche Ave., Kings Heath, Birmingham. [4885

MAGNETIC sound recording wire, stainless steel, temporary wooden spools, approx. 1½ hours' running time at 2ft per sec., 14/- per spool.—A. Smart, 40, Grange Rd., Halesowen.

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WIRELESS World televisors

FOR approved components all enquiries should be addressed to the makers, "Handyparts," 226-228, Merton Rd., Wimbledon, S.W.19. Lib. 7461. S.a.e. for replies. [0055

TRANSFORMERS to exact specification.

LINE O/P trans., for W.W. televisor, 45/-; O/P trans., for Williamson amplifier, 75/-; mains trans. for Williamson pre-amp and radio feeder unit, 60ma O/P, 28/6; television filament trans., 6.5v 8amp and 2, 4, 6.3v 2amp, 28/6; tag panels fitted as specified, trans., for amplifiers, televisors, valve testers, test gear, chargers, etc., to any published specification, or to your own design.

E.P.D. TRANSFORMER PRODUCTS, 51, Queenstown Rd., Battersea, S.W.8. Tel. Mac. 4180. [4579

TELEVISION. HANNEY OF BATH offers:—

POLYSTYRENE and Paxolin formers for the "Wireless World" superhet receiver. All other components are available ex-stock; condensers, resistors. Reliance potentiometers, aerials, etc. COMPLETE set of 20 coils, wound exactly to specification, with copper and brass slugs, London or B'ham, 45/-.

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TELEBOOSTERS for long range television reception, super high gain single-stage pre-amplifier, 2-stage, 1 VR91 valve slug tuned London or Birmingham, co-axial plugs and sockets flying leads for high and low tension, fully screened, low noise, price £3/12/6, power units for above, £3/10; s.a.e. for trade test report.

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**LABORATORY GEAR.** Sullivan Marine Galvo suspended Moving Coil, on solid base with adjusting feet, in lacquered brass case, **£10.** Sullivan Testing Keys, Reversing, **£4.** Weston Moving Coil Relay 380 ohms resistance 50 micro amps, **£3/10/-.** Sullivan Moving coil Relay, **£3.** G.P.O. Polarised Relays in brass case with glass top, plat. contacts, **35/-.** G.P.O. Sounders, **35/-.** Pitkin Lab. Resistances 50 ohms 2 amps. mounted in polished wood base with glass front and heavy ebonite control knob, **40/-**; few with damaged glass **25/-.** Avo-All Wave Oscillator 95 Kc to 40 megacycles in 6 ranges, brand new, **£20** each. Bridge Megger 500 volts 40 megs. with decade Resistance box in wood cases, **£25.** 250 volts 20 megs., **£20.**

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**D.C. DYNAMOS.** 12 volt 10 amp. C.A.V. 1,400 r.p.m., **£2.** 24 volt 100 amp. 4,000/6,000 revs., **£5/10/-.** 30 volt 5 amp. 1500 revs., **35/-**, carriage or any Dynamo, 5/-.

**A.C. MOTORS.** Small sewing machine motors, 230 volts A.C., square construction, with pulley belt and bracket, **£4/10/-**; foot control, **55/-** extra.

**LIGHTING PLANTS.** A.C. Onan Plants, 2½ kVA 110 volt 3.7h.p. 2 cy. 4-stroke air cooled 1,800 r.p.m. Generator 110 volt 21.7 amp., S.P. new Government surplus, **£40** each. 3kW 3-phase plant, 5 h.p. 1-cy. 2-stroke air cooled, Gen. 380 volt, **£50.**

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**A.C MOTORS.** ¼ h.p. 230 volt 1,425 r.p.m., new **£5/10/-.** ½ h.p. capacitator start 230 volt 50 cy. s.c. 1,475 r.p.m., **£8/10/-.**

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**PUMPS.** Rotary Suds Pumps 8ft. lift, 35ft. head, 60 g.p.h., with pulley, **£4/10/-.**

**MOTOR PUMPS.** Suds type ½ h.p. 200 or 400 volt 3-phase 50 cy., 1,425 r.p.m., 10ft. head, 600 g.p.h., **£8/10/-.**

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SYNCHRONOUS clock units, self-starting, 200-250v ac 50 cycle, fitted Sangamo motors, consumption 2½ watts, size 2in. dia., 2in deep, geared 1 rev 60 min. friction reset; ideal movements for making electric clocks, time switches, etc., nickel plated finish, connie. with 12 to dial train and 5in bands price 22/6, post paid. Sangamo as above, final speed one rev. per min. less dial train, ideal for dark-room process time, etc., price 20/- each, post paid.

SANGAMO motors with rear train final speed 1 rev 12 mins approx. 16/- each; ditto, final speed 1 rev 1½ mins approx. 13/6 each, post paid.

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AC mains 250v 50 cycles power packs with variable output, 500v dc at 10ma, to 200v dc 250ma, housed in nicely finished metal cabinet size 11in.×6½in.×6in. complete with 5Z4G rectifier, also gives 18v ac 1amp, £2/10 each, post paid.

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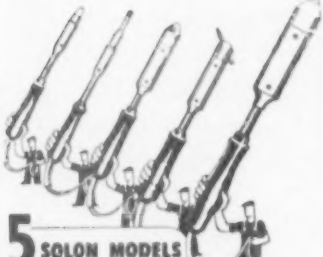

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ALLWAVE a.c. kits, 5 valves, including rectifier, panel and chassis, ready drilled, supplied with medium wave coil; carriage paid £5/10, extra coils 4/6 each. RADIO-AID, Ltd., Retail Section, 29 Market St., Watford, Herts. [0056

MIDGET volume control of the future, diameter the size of a halfpenny, 5in spindle, from 50,000 ohms to 2 meg., with switch, 6/-; d.p. switch, 7/6; leg switch, 4/-; post free; trade enquiries invited.—D. Diamond, 15, Saxon Av., Manchester 8. [4787

TELEVISION.—Bel P.M. Focus Rings approved "Electronic Engineering," self-supporting, micrometer adjustment, Tonmal magnet, chrome finish, all tubes 3 or 12in. with instructions, 35/-. Coils: KF, Birmingham, 18/6; ditto less chokes, 16/6; EE London, 15/-; Wireless World s'het L. or B., 20 coils, 52/6; set of 10 coils for the newest television, 16/-; booster choke, 4/6; video choke, 1/6; chassis kits, with v-h and aromatics, 57/6, as Ferranti but with our own mod. for Midland freq., whole set, 29/6. W.W. s'het chassis kits, comes and aluminium, semi-drilled, including 3 r.f., 2 timebase, 1 r.f. chassis, 11 screening boxes, £6; alternatively, 2 r.f. chassis only with 17 associated coils, £2, plus 2/6 per screening box. W.W. deflector coils, exactly to specn., 35/-; H.F., H.H.T. osc. coils, 6kv., £1, e.c.t. supplied; Williamson r.f. feeder unit, 7/- set of 2 coils, or set of six £1; Attenuators as described on "Wireless Trader," per set, 24/-; sets of 10 preferred resistors available. BEL SOUND PRODUCTS Co., Marlborough Yard, Archway, N.19. North 1025. [4496

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## COMPONENTS—SURPLUS AND SECONDHAND

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CABLES by famous makers. 7/.044 single core, V.I.R., taped, varnished calico taped, asbestos roved, cotton braided and varnished flameproof cable, 250 volt, colours green, yellow, red, blue, £9/18 per 100yd; 1/.064 single core flameproofed braided cable, 250 volt, colours red, black, green, yellow, red/black, blue/white, yellow/green, £2/- per 100yd; 3/.036 single core, rubber insulated, taped, lead alloy sheathed, braided and fireproof compounded cable, 250 volt, £5/7 per 100yd; ditto 7/.036 single core, £7/15 per 100yd.

CAPACITORS by famous makers (post-war manufacture): 50mfd 50v dc peak waxed tubular electrolytics, 3/- (52/- doz); 25mfd 25v dc working aluminium cased tubular electrolytics, 2/2 (23/- per doz); solar metal box cased air-sealed non-inductive 0.1mfd 1000v dc working, 1/4 (14/- per doz); postage stamp moulded mica 0.001mfd 1000v dc working, 1/9 (18/- per doz); tubular rubber sealed non-inductive 1mfd 250v dc working 1/6 (18/- per doz); 0.5mfd auto suppressor condensers in sealed metal case with flying lead, 2/- (21/- per doz); ditto with heavy mounting lug, 2/4 (25/- per doz); tubular rubber sealed non-inductive 0.1mfd 150v dc working, 9d (7/- per doz); waxed tubular non-inductive 0.005mfd 1000v dc working, 1/- (10/- per doz); waxed tubular 0.005mfd 600v ac working, 1/6 (15/- per doz); waxed tubular 0.001mfd 600v ac working, 1/2 (12/- per doz), the following waxed tubulars 350v dc working 0.5mfd, 2/- (21/- per doz); 0.25mfd, 1/6 (15/- per doz); 0.1mfd, 1/2 (12/- per doz); 0.05mfd, 1/- (10/6 per doz); 0.02 and 0.01mfd, 10d (8/6 per doz); 0.005mfd 500v dc working, 10d (8/6 per doz); moulded mica capacitors 0.001mfd, 1/6 (15/- per doz); 300pf, 200pf, 100pf, 50pf, 10d (8/6 per doz).

ACCESSORIES. 7½in diam loud-hailing reflex horn speakers, 55/-; car radio, 6in extension loudspeakers in non-resonant baffle with adjustable mounting, 55/-; side mounting car aerials, two-section telescopic rod aerials, approx. 6ft 6in extended, 22/6 (carr. and packing 4/6 extra on less than ½ doz).

RESISTORS. ¼ watt, 5d each as follows: 1 meg, 1½ meg; ½ watt, 5d each as follows: 56ohm, 120ohm, 150ohm, 300ohm, 3.3K, 5.6K, 11K, 27K, 47K, 51K, 62K, 68K, 100K, 250K, 750K, 1 meg; ¾ watt, 4d each as follows: 15ohm, 56ohm, 60ohm, 100ohm, 120ohm, 500ohm, 1K, 3K, 4K, 5K, 5.1K.

SPECIAL quotations for quantities, dealers, wholesalers and manufacturers supplied; for further materials and components, etc., see our display advertisement in this issue; terms: c.w.o. (or c.o.d. inland over £1 on post goods only); please include sufficient to cover carriage and packing extra if under £2; overseas orders carriage and packing extra.

CAR & GENERAL RADIO, Attenbury Lane, Timperley, Cheshire. Tel. Sale (Manchester) 2214/5. Telegrams and Cables "Motol," Altrincham. [4856

MINIATURE output trans., 65/-, 10d each; condensers, 500+F×50v, 9d; 1+F×1KV, 6d; W.W. pots 10kΩ long spindle, 1/-; 500V mica, spin, 9d; toggle switches, 6d/-½ gross 4BA×⅜in bolts with nuts, and ditto 6BA, the lot, 4/5; valve holders, ceramic loctals, 6d; int. octals, 4d; 465kc I.F. trans. iron core, 2/11.—Hatfield Radio, 78, Stroud Green Rd., N.4. [4866

TELEKIT SUPPLY Co.—If its range you want, build the S.L.C.4 superhet televisor, S.L.C.4 W.D. receiver, complete with valve and wiring diagram and list of spare parts required, 45/-; S.L.C.4 Monitor units, utilising 2½-inch V.C.R.139, ideal oscilloscope cabinets, detachable top, hinged viewing hood, empty unblemished chassis 44/-; with scanning components and valves, 15/-; complete with C.R.T., 27/6; moving coil microphone, as new, 5/- each, 5/- pair. c.w.o. post your requirements to:—

TELEKIT SUPPLY Co., 37 Station Approach, Hayes, Kent. [4874

NO. 19 transmitter-receiver units.—Once again we have been fortunate to secure a limited number of these useful chassis. They were, in most cases, brand new, and of Canadian manufacture, but to conform to regulations were partially dismantled by the Ministry before release and are sold by us for the many components, which include: 1 4-gang 0005 tuning condenser, 1 single 0005 tuning condenser, each fitted with slow motion dials, 3 I.F. transformers, approx. 15 valve holders, several Pots, Yaxley type switches, ceramic trimmers and several dozen condensers, resistors, etc., our special price is 12/6 carriage paid. We regret that when we last advertised these chassis the colossal demand exhausted all our stocks and we were forced to disappoint certain customers. If these customers will again apply, their orders will have preference.

POWER unit for the above works direct from a 12 or 24v battery and is actually 2 units in one (a rotary transformer and a vibrator unit), output 265v at 120 m/a and 540v at 26 m/a, brand new, Canadian manufacture; also contain fuses, indicator lamp, change-over switches, etc., a few only, at 49/6 carriage paid; we can also supply a rectifier unit Mallory type G654C for 10/- if ordered with this unit.

TELEVISION Enthusiasts!—Low loss Di-pole insulator, with heavy brass stubs, for your own elements, to suit London or Birmingham, the basis of any ultra efficient aerial installation, only 5/- each; send s.a.e. for latest lists.

WALTON'S WIRELESS STORES, 203 Staveley Rd., Wolverhampton (mail orders), 46, Stafford St., Wolverhampton (callers only). [4061


# THESE ARE IN STOCK

**Television Explained.** By W. E. Miller. 5s. Postage 5d.

**Practical Wireless Circuits.** By F. J. Camm. 6s. Postage 5d.

**Fundamentals of Radio-Valve Technique.** By J. J. Deketh. 3½s. Postage 1s.

**Amateur Radio Receivers.** By S. K. Lower. 3s. 6d. Postage 2d.

**Radio Valve Data.** Compiled by the "Wireless World." 3s. 6d. Postage 3d.

**Basic Television.** By Bernard Grob. 25s. 6d. Postage 1s.

**Frequency Modulated Radar.** By D. G. C. Luck. 34s. Postage 1s.

**Amateur Radio Simple Transmitting Equipment.** By W. H. Allen and J. W. Mathews. 3s. Postage 2d.

**Recent Advances in Radio Receivers.** By L. A. Moxon. 18s. Postage 6d.

**The Radio Amateur's Handbook.** By A.R.R.L. 15s. 6d. Postage 9d.

**The Technique of Radio Design.** By E. E. Zepler. 23s. Postage 9d.

**A Home Built Televisor for Sutton Coldfield Reception.** By W. I. Flack. 4s. 6d. Postage 3d.

**Wireless Servicing Manual.** By W. T. Cocking. 10s. 6d. Postage 5d.

We have the finest selection of British and American radio books. Complete list on application.

**THE MODERN BOOK CO.**

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**19-23 PRAED STREET**

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# HAZLEHURST DESIGNS LTD.

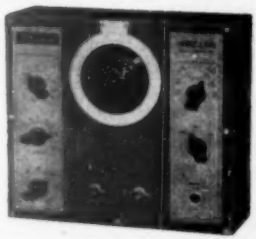
# R.F. E.H.T. EQUIPMENT

In order to meet the increasing demand for all types of our E.H.T. equipment, we have pleasure in announcing the purchase of a larger factory at the address given below, where both Office and Works are now situated. With the enormously increased facilities available, we are planning to increase the range of equipment offered and also to speed up deliveries. Enquiries welcomed for all equipment between 2,000 and 50,000 volts at currents up to 1 mA.

**34, POTTERY LANE, HOLLAND PARK, W.11.**

*Phone number to be announced later*

# *When Quality Counts . . . .*



. . . the *HOMELAB* Signal Generator is a wise choice. But there is a snag—we cannot give immediate delivery. The fact is that the large demand for this instrument has, until recently, exceeded our manufacturing capacity. Some of our customers have had to wait longer than was anticipated, but we have now obtained additional premises for the production of the *HOMELAB* and are able to make lots more of them. During the next few weeks we will be able to get right up to date with orders. We offer our apologies to those who have patiently awaited delivery—but we gather from the letters we receive that the *HOMELAB* is well worth waiting for.

May we remind you that the *HOMELAB* Signal Generator has the following features :

- 100KCS. to 130 MCS.
- 30 per cent. MODULATION AT 400~ or
- UNMODULATED CARRIER
- PROVISION FOR EXTERNAL MODULATION
- OUTPUT IMPEDANCE 10Ω
- LOW EXTERNAL FIELD
- BUFFER STAGE
- VARIABLE 400~ OUTPUT
- ACCURACY OF CALIBRATION ±1 per cent.
- A.C. MAINS OPERATION ONLY.

**PRICE £6 : 11 : 0** plus 5/- for packing, etc.

Please send S.A.E. for full technical details and enclose P.O. for 2/6 if circuit diagram required. The *HOMELAB* Signal Generator can be seen at our new showrooms—the address is HOMELAB INSTRUMENTS, 374, High Road, London, E.11—but orders can only be accepted by post and these, together with all enquiries should be addressed to :—

**HELY-MANN ELECTRONICS LABORATORIES**
**116, GROVE RD., LONDON, E.17.**


## COMPONENTS SURPLUS AND SECONDHAND

RADIO CLEARANCE, Ltd., 27 Tottenham Court Rd., London, W.1. Tel. Museum 9188. 20watt high fidelity amplifier kits for construction, using the McMurdo, 8-valve, AC/DC amplifier, low impedance input (suitable for moving coil mikes, etc.), by triple shielded trans. to E.F.37, R.C. coupled to triode strapped stage (EF37), with switched bass and top cut provided, trans coupled to output stage using four CL33's in parallel push pull, large O.P.T. (matches to 10 or 15) rectifiers two GRSC's parallel, alternative high impedance input to second stage, for Xtal pick-ups, tuner units, etc., required inputs for full output, high imp. 0.5v r.m.s., low imp. 1millivolt, V.C. operates on both inputs, chassis isolated from mains, complete kit of first-class components (including Partridge trans), all valves, black crackle chassis (ready drilled), black crackle and chromium case (15½ in×6½in×8in), circuit diagram, etc., everything required for the construction of a fine job, £15/15, carr. paid.

MANSBRIDGE Condensers, 4mf 1,000v. WKG (2⅝in×4in×1¼in), 5/-; 6mf 2,000v Test (3in×4in×1¾), 4/-; 3mf, 2,500v Test (6½in×5½in×2½in), 2/6; 25mf (7in×5in×2in), inc. term. 6,000v Test, 5/6; 2mf 2,500v WKG (6in×5½in×2½in), 4/-; post extra.

PERSONAL receivers, 3-valve T.R.F. receivers using I.T.4's, contained in handsome Bakelite case, with lift up lid, size 7in×6½in×5in with lid closed, plastic carrying handle. Frame aerial in lid, these receivers cover the medium waveband and operate from self-contained standard size, dry batteries, types W1435 and U2, output to a pair of lightweight high resistance phones, 2 gang conds with s.m.d., opening the lid switches on, supplied brand new in maker's carton, with valves, phones and batteries, an ideal set for children, invalids, and many other purposes, these receivers are not Govt. surplus, and are offered ready to play, £3/19/6, carr. paid. 360-0-360v 220ma, 4v 6a C.T. 4 5a, 5 5a, trans., input 210/250, 50c/s, new, 32/6, carr paid. T.V., line transformers, shielded in all cans with T.C. lead (used with PEN46), 11/6, chassis (steel) 3×5½×1½in, drilled 4 button base holes, 1/9; 5.X9½×1½in, drilled 7 button base holes, 2/3; all 17×19½×2½in, drilled 7 int. oct. and square open-ends, 3/3; E.H.T. trans. 4kv 1ma, 2v 2a, Pri. 250v 50c/s, 29/6; rec. R 1481 covers 65-65Mc/s, 10 valves, (6 5v), tuning meter, 6in SM dial, circuit diagram, etc., brand new, in transit case, £4/4, carr. paid. personal receivers B.C.728c, 7 valve rec. using 1.4v valves, with 4 push buttons covering 2-6Mc/s, built in L/S, supplied brand new complete with valves (1T4, 1R5, etc.), 2 and 12v VIB, 2v acc., telescopic A.E., instruction book, etc., £8/19/6; auto trans., 200-250v-11 v. 60W rating enclosed, 18/-; special line auto, 230/110v, 100W, 9/6; smoothing chokes, 5H 120mA, 100/1, 3/3; 5H 200mA, 100/1, 4/11; 6H 250mA, 100/1, 5/6; 5H, 250mA, 90/1, 7/6; electrolytics, 8mf 150v, 1/3; 8/170v, 1/3; 8/450v, 2/3; 16/350v can, 2/3; 16+8 450v large can or divided, 3/6; 8+32 450v can, 4/-; 16+24+8 450v can, 5/-; 32 450 large can, 2/9; 16+8 550v can, 5/-; 60+100 350v, 3/-; 32 350v can, 2/3; 100mf 6v, 6d; 25/25v, 1/3; 100/25v, 1/6; 25/50v, 1/3; 16/350 card, 1/9; 24/350 can, 2/-; 8+24 350v can, 2/6; P.M. loudspeakers 5in less trans., 9/11; with trans. 4.500/1, 11/6; 6½in less trans., 10/11; 10in with trans., 21/-; R.F. units type 24, 8/6; with valves, used in good condition, post 1/6 extra please; output trans. 2,000/1, 2,500/2/1, 2,750/1, 5,000/2/1, 5/-; 4,500/2/1, 7,000/4/1, 5/6; 5 ratio 7,000/3,500/1,750/4/1, 4/-; heavy duty 7,000/2/1, 5/6; I.F. trans., 465 Kc/s small size, iron cored, 7/6 pr.; 2 gang conds, .0005 ceramic ins., 1in standard spindle, 4/6; ceramic switches 2p., 5w, 1B, 2/-; 5p., 5w, 1B, 2/6; switches, standard size 2p., 4w, 1B (additional wafer with shorting plate), 2/6; 2p., 4w 3B, 2/6; 1p., 10w 2B, 2/6; all have 5in spindles; resistors 100 assorted, 47 values ranging 180Ω to ½w-100K 5w, standard sizes, best make, 10/6; post 6d; ceramic trimmers, 5/50pf, 1/-; n a bar, 1/5; 1/15pf single 4d; 5/50pf air spaced concentric, 6d; 5/25pf U.I.C. type, 5d; air spaced variable ¼in spindles 25pf, 50pf straight, 50pf diff., ceramic bases, 1/-; 55pf butterfly, 1/-; our radio vibrator packs with 12v 4 pin VIB and OZ4 valve on chassis 5½×5½×1½in output 250v 65mA output brought out on 8ft screened lead, 17/6; meters, moving coil, new, cased, 2in circular 0/500 microA, 7/6; 0/15-600v rec. ext. res. 6/6; 0/20 or 0/40A with shunt, 5/-; Bakelite cased 2in square 0/1mA, 7/6; 0/5mA, 6/-; 0/50mA, 7/-; 0/500v series res. supplied 7/-; Bakelite cased 2½in circular, 0/500microA, 16/6; 0/50mA, 7/-; 0/50mA, 8/6; 0/100mA, 8/6; 0/200mA, 8/6; 0/15v 7/-; 1mA desk type, 15/-; visual indicators type 1 crossover needle with 2 separate 60m cmA movements, 5/-; S.M. dials as on R.F.28, etc., 5/11; ex-Admiralty pair, 1257 1½in engraved 0-100, fast/slow (50-11, panel mounting, fits ¼in spin., 2/6; rotary power units type 104 12v D.C. input, outputs 250v 60mA 6.5v 2.5mA P.M. rotary mounted on chassis with supp., 6/11; type 87 outputs as above but 24v input, 5/11; 10-valve receivers R.26/ARC5, cover 100-156 Mc/s, brand new with valves (inc. 6-717 A.C.), 42/6; Wilcox Gay V.F.O. covers 2-10 Mc/s, with 0-10 mA meter, supplied brand new in original carton, with 807 access rics (plugs, leads, etc.) and instruction book, £5, carr. paid. Wilcox Gay Xtal multipliers 2-7 Mc/s, brand new, with 807 plugs, leads, instruction book, etc., in original cartons 40/-, carr. paid; superhet coils ¾×1½in formers M.W., HF, AE, osc., L.W. HF, AE, osc., 1/6 per coil; I.F. traps iron cored 465 Kc/s 1/9, set of 6 coils and trap 9/6; 7 or 10 pin plugs and sockets with keyway 1/6 pr.; 8-way Jones plugs and sockets with cover, 1/6 pr.; V.C. carbon with sw. 2½in spindle 5K, 25K, 50K, 100K, 250K, 4/-; 5 watt wire-wound no

(Continued on page 78)


**MAINS TRANSFORMERS, FULLY INTERLEAVED, SCREENED AND IMPREGNATED. ALL PRIMARIES ARE 200/250 v.**

**Half Shrouded**

| | |
|---|---|
| **HS63.** Output 250/0/250v. 60 m/a. 6.3v. at 3 amps. 5v. at 2 amps | 15/6 |
| **HS40.** Windings as above. 4v. at 4 amps. 4v. at 2 amps | 15/6 |
| Output | |
| **HS2.** 250/0/250v. 80 m/a. | 17/6 |
| **HS30.** 300/0/300v. 80 m/a. | 17/6 |
| **HS3.** 350/0/350v. 80 m/a. | 17/6 |
| **HS2X.** 250/0/250v. 100 m/a. | 19/6 |
| **HS30X.** 300/0/300v. 100 m/a. | 19/6 |
| **HS3X.** 350/0/350v. 100 m/a. | 19/6 |

**Fully Shrouded**

| | |
|---|---|
| Output | |
| **FS2.** 250/0/250v. 80 m/a. | 19/6 |
| **FS30.** 300/0/300v. 80 m/a. | 19/6 |
| **FS3.** 350/0/350v. 80 m/a. | 19/6 |
| **FS2X.** 250/0/250v. 100 m/a. | 21/6 |
| **FS30X.** 300/0/300v. 100 m/a. | 21/6 |
| **FS3X.** 350/0/350v. 100 m/a. | 21/6 |
| All the above have 6.3-4-0v. at 4 amps. 5-4-0v. at 2 amps. | |
| **FS43.** Output, 425/0/425v. 200 m/a. 6.3v. 4 amps. C.T. 6.3v. 4 amps. C.T. 5v. 3 amps. Fully shrouded | 42/6 |
| **FS50.** Output, 450/0/450v. 250 m/a. 6.3 v. 2 amps. C.T., 6.3v. 4 amps. C.T. 5v. 3 amps. Fully shrouded | 62/6 |
| **FS30X.** Output, 300/0/300v. 80 m/a. 6.3 v. 7 amps. 5v. 2 amps. Framed, Flying leads | 26/6 |
| **FS35X.** Output, 350/0/350v. 250 m/a. 6.3v. 7 amps., 4v. 8 amps., 4v. 3 amps., 0-2-6.3v. 2 amps. Fully shrouded | 59/6 |

**FILAMENT TRANSFORMERS**

| | |
|---|---|
| **F4.** Output, 4v. 2 amps. | 7/6 |
| **F6.** Output, 6.3v. 2 amps. | 7/6 |
| **F12.** Output, 12.6v. tapped 6.3v. at 3 amps | 15/6 |
| **F24.** Output 24v. tapped 12v. at 3 amps. | 21/6 |
| F12 and F24 framed with Flying Leads | |
| **FU6.** Output, 0-2-4-5-6.3v. at 2 amps. | 9/- |
| **F29.** Output, 0-2-4-5-6.3 v. at 4 amps. | 15/- |
| FU6 and F29 clamped with Flying Leads | |
| **FS.** Output, 6-3v. at 10 amps., 5v. at 10 amps., 12.6v. at 5 amps., 10v. at 5 amps. | 31/6 |
| **F6/4.** Output, four at 6.3v. tapped at 5v. at 5 amps. per winding, giving by suitable series and parallel connections 24v. at 5 amp.; 20v. at 5 amp.; 18v. at 5 amp.; 15v. at 5 amp.; 12.6v. at 10 amp.; 10v. at 10 amp.; 6.3v. at 20 amp.; 5v. at 20 amp. | 47/6 |
| FS and F6/4 framed with Flying Leads | |

**OUTPUT TRANSFORMERS**

| | |
|---|---|
| **MOP1.** Ratios 26,46, 56, 66, 90, 120-1, 50 m/a. max current. C.T. for Q.P.P. Class B, etc. Secondary 2/4 ohms. Top panel and clamped, each | 5/- |
| **OP1.** Midget Power Pentode, ratios 30, 60, 90-1, 40 m/a., Secondary 2/3 ohms, each | 3/2 |
| **OP2.** Midget Pentode, ratios 45-1, Secondary 2/3 ohms, 40 m/a. per dozen | 33/- |
| **OP10.** 10/15 watts output, 20 ratios on Full and Half primary | 16/3 |
| **OP30.** 30 watts output, 20 ratios on Full and Half primary | 23/9 |
| **Williamson's O.P. Transformer** to Author's specification | £3/12/6 |
| **The following framed with Flying Leads :** | |
| **EHT.U.** Tapped EHT. 1,500v.-2,000v., 2,500v.-3,000v. up to 5 m/a., 2-0-2v. at 1.5 amps., 4v. at 1.5 amps | 42/6 |
| **EHT.1.** 1,000v. 5 m/a. 2-0-2v. 2 amps., 4v. 1.1 amps | 33/6 |
| **EHT.2.** 2,000v. 5 m/a. 2-0-2v. 2 amps., 4v. 1.1 amps | 35/- |
| **EHT.2S.** 2,500v. 5 m/a. 2-0-2v. 2 amps., 4v. 1.1 amps | 36/6 |

C.W.O. (add 1/- in £ for carriage); all orders over £2 carriage paid.

**H. ASHWORTH**
**(Dept. W.W.)**
**676 ST. HORTON RD., BRADFORD, YORKS**

# AMC

## TELEVISION

Manufactured to "*Electronic Engineering*" Televisor Specification.

**MIDLAND T.V. Sound and Vision Panels** fitted with formers and dust cores now available.

**LINE OUTPUT TRANSFORMERS**

**NEW Improved SET OF GANTRIES COMPLETE**

**FOCUS COILS**

**LINE AND FRAME SCANNING COIL ASSEMBLIES**

**All Steel CADMIUM PLATED POWER AND TIME BASE CHASSIS** valve-holders, 5 point and single socket and all necessary cut-outs.

**SOUND PANEL CHASSIS ASSEMBLY,** fitted with screens, valve-holders, formers and dust cores.

**VISION PANEL CHASSIS ASSEMBLY,** fitted with screens, valve-holders, formers and dust cores.

**9" C.R. TUBE SUPPORT** for mounting on top of Gantry Assembly.

**9" CREAM MASKS.**

**5, SHAKESPEARE RD., FINCHLEY, N.3**
Phone: FINchley 2188



## PAPER DIELECTRIC CONDENSERS

Super quality, by a famous British manufacturer. In moulded Bakelite cases, Neoprene sealed ends, 1in. diameter by 2½in. long, plus terminal tags. Capacitance 0.01 $\mu$F. Working Voltage 5,000 D.C. at tropical temperature. Countless uses, including breakdown-free suppression, etc. Unused, and offered whilst stocks last at only **10/-** per dozen, post paid. C.W.O. please, despatch at once. Enquiries invited for very large quantities. Don't miss these!

**WIRELESS SUPPLIES UNLIMITED,**
**264-266 Old Christchurch Road, BOURNEMOUTH, Hants.**


### COMPONENTS SURPLUS AND SECONDHAND

(Continued from page 77)

twin w/s 2.5a/4.5a, 2/-; 5U4G, 2/-; 50K, 50K, 5/-; twin carbon 1m/1m, 2/6; all telescopic aerials, 15in closed 7ft 6in extended, 5/6; receivers type 958, 150-505 Kc/s, 5 valves ARTH. VR54 VR56 TF, superhet 550 Kc/s, brand new, in transit case, 22/6, carr. paid. RADIO CLEARANCE, Ltd., 27 Tottenham Court Rd., London, W.1. Tel. Museum 9168. (3013

BRAND-new ex-R.A.F. power units containing 0-1ma m/c meter, meter rectifier, 2 x 32 mfd. 600UDC condensers, 2 x 500ma 20 Henry I.T. chokes, heavy duty mains transformer input 250 volts 50 cycles, output 350-0-350v at 500ma, 2 x 6.3v, 5a, 20-0-20v, 2 x KF50, EA50 5U4G. Condensers, resistances, thermal delay switches, fuses, etc., all in wooden packing case, bargain at £6/15, carriage paid. TELEVISION—5000v rectifier V1907/960 4x fil. 6/-; conds. 0.25 1000v, 8/- doz; 0.05 2.5kv, 0.05 5.5kv, 1/- each; 0.1 6kv, 5/6 ea. 4mf 425v micropacks, 10/6 doz; condensers 0.01 1000, 5/- doz; 0.25 500, 5/6 doz; 0.25 1000, 6/6 doz; 4mfd. 1/- ea; many other items, s.a.e. list. Cross, Herries, Cross Lane, Grange, West Kirby, Cheshire. (3749

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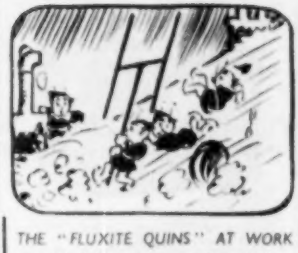

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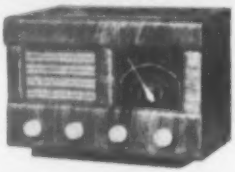

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"SERVICE with a smile."—Repairers of all types of British and American receivers; coil rewinds, American valves, spares, line cord.—F.R.I., Ltd., 22, Hoxton St., W.1. Museum 5675. [1575

RADIO MAINTENANCE SERVICE for guaranteed rewinds and repairs; armatures, F.H.P. motors, vac. units, power tools etc.; good deliveries.—139, Goldhurst Terrace, N.W.6. Mal. 6155. [9925

"STURDY" rewinds, mains transformers, chokes, and fields, first-class work, prompt deliveries and satisfaction guaranteed.—Sturdy Electric Co., Ltd., Dipton, Newcastle-on-Tyne. [2450

A SECOND-to-none rewind service, reliable, neat, return of post service; your television requirements promptly executed, EHT, LHT and heater transformers; stamp for quotations.—R. E. P., 137a, Ashton Rd., Oldham. [5519

24-HOUR service, 6 months' guarantee, any transformer rewind, mains outputs and L.L.s., etc.; all types of new transf., etc., supplied to specification; business heading or service card for trade prices.—Majestic Winding Co., 180, Windham Rd., Bournemouth.

L.T.P. rewind service, all rewinds are layer wound, vacuum impregnated, pressure seeted at 2,000volts and guaranteed for three months, 48-hour service.—Enquiries, London Transformer Products, Ltd., L.T.P. Works, Cobbold Estate, N.W.10. Tel. Willesden 6456.

METROPOLITAN RADIO SERVICE for rewinds, mains and E.H.T. transformers, chokes and field coils; delivery 3-5 days; new transformers designed and manufactured singly or in quantities.—Metropolitan Radio Service Company, 1021, Finchley Rd., London, N.W.11. Tel. Speedwell 3000.

REWINDS.—Send your "burn outs" to be rewound; no technical data wanted; post transformer, etc., labelled with your name, address, and marked "for rewind"; our windings are double wound, interleaved and impregnated.—Southern Trade Services, Ltd., 297-299, High St., Croydon. Tel. 4870. [5110

## WORK WANTED

WE make wireless and radiogram cabinets for home and export; immediate delivery.—Radiac, Ltd., 88/90, Caledonian Rd., London, N.1. Tel. Terminus 7447. [8025

SPECIAL receivers, test gear, electronic apparatus, experimental and design work.—If you have a problem which needs expert handling, write in first instance to J. Moir, B.Sc., A.M.I.E.E., BCM/HIFIDEL, London, W.C.1.

DRAUGHTING, tracing and photoprinting services, estimates free; contractors to the Ministry of Supply and the Admiralty for drawing and tracing work to their requirements and specifications, sub-contracting work of this nature undertaken.—DRAWING & TRACING, Ltd., 356a, Ewell Rd., Tolworth, Surbiton. Tel. Elmbridge 7406. [4185

FIRST-CLASS transformers and chokes manufactured, stock lines available; also special manufacturers' components made to specifications, armatures and fields wound and motors assembled.—Avis & Baggs, Ltd., 140-141, Friar St., Reading, Berks. [2715

## MISCELLANEOUS

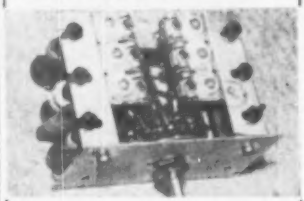
WALNUT radiogram and television cabinets, mantls, samples few only, stamp details.—Walters, 501, Hale End Rd., E.4. [4057

WALNUT radiogram cabinets, £18; new 12in speakers, 45/-; stamp details.—Cabinetware, Summit Works, Heys St., Blackburn.

RADIO and television cabinets made to individual requirements.—Sketch and details to Burman's, 64, Reighton Rd., London, E.5. [4755

ENGRAVING, amateurs and trade could take the opportunity of engraving problems in the future by getting in touch with A. O. Engraving, 19a, Windmill Rd., London, S.W.18. Brass, bronze, erinoid, perspex, dials; one knob or repetition equally entertained. [0084


# ALLEN COMPONENTS LTD.



**Type 300 3-wave band coil unit**

A reasonably priced assembly of exceptional performance consisting of switch, complete set of aerial and oscillator coils with all associated trimming and padding condensers. Improved aerial coupling system gives high sensitivity with exceptional discrimination against unwanted signals. A four position switch gives facilities for gramophone pick-up connection and RF muting. Suitable for use with any of the standard frequency changer valves and an IF frequency of 455Kc. Calibrated glass scale available.

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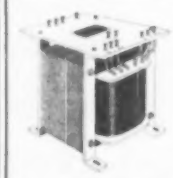

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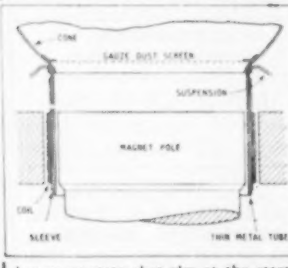
About this time last year we prepared to reduce our output and enter the back room for the summer recess : but to our confusion (and to our bank manager's joy) the plan had to be re-cast. Whether the financial results of Christmas were better than expected for many people ; whether owners of 148As had invited many friends to hear Barker quality, or whether our January story was especially persuasive we shall never know. The fact remains that our postbag and sales shot up to new levels and have stayed there ever since.

One interesting point is that quite a fair proportion of our letters begin : "I am told . . ." or "I heard your 148A . . ." instead of "I read . . ." This means that our friends and our products are speaking for us as well as our advertisements and leaflets. Some of our friends are of course those enterprising dealers who realise that good quality sound is good business as well as an enduring joy. Most, however, are owners of 148As who, like us, keep on getting thrills of pleasure at fresh revelations of what we aim at in

NATURAL SOUND REPRODUCTION




Let us re-state that aim at the start of a new year. It is to reproduce sound as naturally as possible by means of a simple and moderately priced electro-acoustic device. To that end we employ the exclusive patented Barker dual drive shown above, the special patented Barker cone with its logarithmically graded corrugations, high flux magnets, and lots of personal care at every operation from start to finish. We make every part we use except the magnet casting, nuts and bolts, and one disc suspension. Though we don't pay too much attention to spit and polish we do watch like hawks points affecting performance. Every Barker unit is a soundly made job and a precision acoustic reproducer.

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### MISCELLANEOUS

REFLEX corner cabinets, Briggs design, 9 cubic ft. cement lined, density factor 5.—Particulars, Hammonds, 97, Queens Rd., Nuneaton. Tel. Nuneaton 5007. [4691

ALUMINIUM chassis and panels, any size and manufactured quickly holes punched for valve holders etc., paint or cellulose finish.—E.A.D., 16, Broad Rd., Willingdon, Sussex.

ALUMINIUM alloy tubing all diameters, thicknesses and lengths, telescopic fittings suitable television or radio masts, prices on application.—Bird, Surplus Stores, Milk St., Bath. [4814

P.E. exposure meter components.—Selenium light cell, 66; microamp meter movement, 10/6; Perspex case, 9/-; ivorine conversion dials, 5/6; assembly instructions, 5/6; s.a.e. full details.

O.R. PRODUCTS, 78, Repton Rd., Bristol, 4.

HIGH vacuum backing pump for sale, 600 cu metres per hour, twin opposed cylinders, 4in driving wheels, countershaft with endless belt and V rope drive to motor pulley.—Tel. Mitcham 5471 (ext. 52). [4645

VACUUM and pressure impregnating plant (new) complete with 15in x 20in deep autoclave, vacuum pump, compressor, electric motors, tank, moisture traps, gauges, cocks, control gear etc.—Box 1457. [4615

FLUORESCENT lighting, 80 watt tapped brick choke, 210-240v a.c. with circuit, 17/9, or kit of parts less 5ft tube, 35/9; slim quick-start 40 watt ballast, 220-250v a.c. with holders, 47/6. List 1d s.a.e.—Maden Transformer Supplies, 200-202, Cambridge Rd., Nutbiton, Surrey. [0058

COPPER wires enamelled, tinned Litz, cotton, C/silk covered, all gauges, BA screws, nuts, washers, soldering tags, eyelets, ebonite and laminated bakelite panels, tubes, coil formers, Tufnol rod; headphones, flexes etc.; latest radio publications, full range available; list s.a.e.; trade supplied.—Post Radio Supplies, 55, Bourne Gardens, London, E.4. [1454

3/6.—For this modest sum we supply you with full constructional details for building our latest 10watt quality amplifier with variable negative feed-back; these constructional sheets are simplified so that the most inexperienced person may build and obtain first-class results. Complete Home Constructor's Handbook with circuit of this and many other sets, 1/- extra.—Supersols, Mail Order Office, 98, Greenway Ave., London, E.17. [0055

BRITISH SOUND RECORDING ASSOCIATION.—Membership is open to all professional and amateur recording engineers and high-quality reproduction enthusiasts. The official Journal, "Sound Recording," Vol. 5, Nos. 1-2-5 available at 2/8 post free. B.S.R.A. Diary for 1950 at 4/6 with eight pages of data on recording and reproducing topics, brochure and application form from Membership Secretary, Harrie J. King, 48, Mount View Rd., N. Chingford, London, E.4. [2119

### SITUATIONS VACANT

*Vacancies advertised are restricted to persons or employments excepted from the provisions of the Control of Engagements order, 1947*

CROWN Agents for the Colonies.

RADIO officer required by East Africa High Commission for Posts and Telegraphs Department for one tour of 48 months in the first instance, commencing salary according to age in scale £650 rising to £715 a year, gratuity of 15½ per cent of total salary payable on satisfactory termination of contract, outfit allowance £50, free passages; candidates, aged between 25 and 35, must possess Postmaster General's First Class Certificate of Competency in Radio Telegraphy, the equivalent certificate of the Air Ministry or the Ministry of Civil Aviation, or other equivalent Service qualifications, and have had considerable experience in the operation of medium and high-frequency radio stations, experience in the operation of modern radio and/or radar navigational aids and the day-to-day maintenance of modern radio equipment an advantage.—Apply at once by letter, stating age, whether married or single, and full particulars of qualifications and experience, and mentioning this paper to the Crown Agents for the Colonies, 4, Millbank, London, S.W.1, quoting M/N 25107 (5B) on both letter and envelope. The Crown Agents cannot undertake to acknowledge all applications and will communicate only with applicants selected for further consideration. [4786

TESTERS, inspectors and faultfinders required. 5-day week, good prospects.—ACE RADIO, Ltd., Tower Works, Tower Rd., N.W.10. Willesden 5004/5. [4774

UNIVERSITY OF DURHAM, Medical School, King's College, Newcastle-upon-Tyne.

TECHNICIAN with practical experience in electronic engineering required for the laboratory of the department of surgery; applicants should be willing to work also in general biological research work; previous laboratory experience of this nature will be an advantage, but not essential as the necessary training could be provided; commencing salary within the range of £500 to £590 according to qualifications and experience; applications, together with the names of three persons to whom reference may be made, to be submitted to the undersigned not later than 15th February, 1950. [4835

SERVICE engineers, radio television, required by leading Bromley dealers; wages £6-£10 for qualified men.—Box 1472. [4849

ENGLISH ELECTRIC VALVE Co., Chelmsford, require a young graduate engineer interested in micro-wave work on radio valves; interesting position with good prospects.—Write, giving full details, quoting Ref. 552, to Central Personnel Services, English Electric Co., Ltd., 24-30, Gillingham St., Westminster, S.W.1. [4821


# BAND SPREAD

by Armstrong

the NEW EXP 119

This model has been produced after exhaustive investigation into the requirements of Overseas Listeners. Ease of operation on the short-wave bands high sensitivity and quality output have all been studied and incorporated in the EXP 119.

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Telephone : NORth 3213

**SOLE BIRMINGHAM AGENT :**
**Hayes Company, 1 Alcester Rd., Moseley, Birmingham, 13.**

**SOLE AGENTS FOR KENYA, UGANDA, TANGANYIKA & ZANZIBAR**
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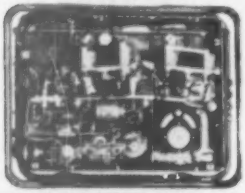
# R.A.F. COMPUTER UNIT



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WIRELESS station superintendent required by Nigeria Government posts and telegraphs department (for aeronautical wireless stations) for 18-24 months with prospect of permanency; salary according to age and experience in scale £660-£990 a year (including expatriation pay), outfit allowance £60, free passages, liberal leave; candidates must hold first-class radio-telegraph operator's certificate, have had recent experience in wireless operating and direction finding apparatus, have thorough knowledge of transmitters and receivers, and be capable of maintaining (under an engineer's instructions) diesel engine sets driving small generators.—Apply at once by letter, stating age, whether married or single and full particulars of qualifications and experience, and mentioning this paper, to the Crown Agents for the Colonies, 4, Millbank, London, S.W.1, quoting M 3, 24564/1951 on both letter and envelope. The Crown Agents cannot undertake to acknowledge all applications and will communicate only with applicants selected for further consideration. [4807

THE UNITED LEEDS HOSPITALS

THE RADIOTHERAPY CENTRE at Leeds.
A TECHNICIAN with electronics experience is required to assist in the construction and use of apparatus for the measurement of the radioactive content of the human body; the work is being carried out on behalf of the Medical Research Council, and the appointment will be temporary in the first place; salary £350 p.a.; application forms obtainable on written request to the undersigned.
S. CLAYTON FRYERS, Secretary to the Board.

COSTING and progress clerk, with experience of communication components, required.
WRITE to Managing Director, giving experience, age and salary required.—Wermouth Radio Mfg. Co., Ltd., Crescent St., Weymouth. [4797

SERVICE mechanic required by leading deaf-aid manufacturer.—Write in first instance, giving details of experience and salary required to Box 1554. [4799

SERVICE engineer required with knowledge of V.H.F. must be capable of demonstrating and servicing high-class equipment and free to travel country with demonstration vehicle.
APPLY Sales Dept., Pye Telecommunications, Ltd., Newmarket Rd., Cambridge. [4805

PILOT RADIO, Ltd., requires immediately fault finders and testers for radio and television adjustment, experienced in factory production; five-day week with good rates of pay. APPLY or write to Pack Sional Rd., London, N.W.10. [4517

ENERGETIC progress man required for purchasing department; experience essential in radio and television.—Apply in person to Stephney-Baird, Ltd., Lancelot Rd., Wembley, Middx. [4827

FERRANTI, Ltd., have vacancies in their radio works, Moston, Manchester, for physicists and engineers for research and development work on vacuum and gas-filled electronic devices, as follows:—
(a) SENIOR development engineers, qualifications include a good degree in physics or electrical engineering and extensive experience in a responsible capacity in the electronics field.
(b) DEVELOPMENT engineers, qualifications include a good degree in physics or electrical engineering or suitable extensive experience in electronics.
SALARY on a liberal basis, according to qualifications and experience; the company has a staff pension scheme.
APPLICATION forms from the Staff Manager, Ferranti, Ltd., Hollinwood, Lancs. [4806

APPLICATIONS are invited for the following appointments concerned with the build-up of a new television laboratory, the Research Laboratories of the General Electric Co., Ltd., in the Stanmore (Middx.) area.
(a) SENIOR Mechanical Engineer, to take charge of a Research Group in the field of special mechanisms; experience in the theory and design of servo devices, high efficiency gearing and modern forms of light constructional methods is essential. The applicant is expected to contribute to the build-up of a mechanical laboratory, which will be an important part of a new organisation to deal with a number of major projects.
(b) SENIOR Mathematician, to take charge of the mathematical work of the new laboratory; a first-class mathematical background is required together with experience in the theory of computing and control systems involving both the electrical and mechanical aspects.
(c) A NUMBER of senior positions requiring experience in one or more of the following fields: (i) microwave circuit design and measurements, including wave guides and concentric lines; (ii) the design of microwave aerial systems; (iii) intermediate frequency amplifier design; (iv) special engineering problems associated with compact lightweight equipment.
(d) TWO Mathematicians, with good Honours degrees and preferably some practical experience of the application of mathematical methods to electrical and mechanical problems.
(e) A NUMBER of vacancies for men qualified in various electrical and mechanical fields, including (i) experimental work on and design of microwave equipment; (ii) video frequency and special waveform generating circuits; (iii) intermediate frequency receiver design; (iv) servo control and computing circuits; (v) experimental and design work on light mechanical engineering problems.
APPLICATIONS should be sent to the Personnel Officer, Research Laboratories of the General Electric Co., Ltd., North Wembley, Middlesex, and should contain full details of qualifications, experience and age. [4802


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**CONDENSERS**, 25 assd.; paper tubular, 12 assd.; mica, 18 assd.; mica wav. 2 - 30 (all postage stamp trimming condensers), 5 concentric (mainly 50 ufd.), 1 split-stator air cond., and 2 two gang or 1 four gang variable cond. **RESISTORS**: 45 assd. fixed, 3 variable potentiometers. **R.F. CHOKES**: 6 assorted. **METER RECTIFIERS**: 2 0-5 mA. **TRANSFORMERS**: 2 (400 kcs) I.F. transformers, 1 output trans., 1 mains auto trans. **OCTAL VALVE BASES**: 14. **VALVE CAPS**: 3. **SLOW MOTION DRIVES**: 2 (with 2 - 8ad Frequency settings). **CONTROL KNOBS**: 5. **SPRING LOADED TERMINALS**: 13 (insulated, transfixed). **SWITCHES**: Yaxley type, 2 (2 rotary, 1 toggle). **JACK PLUG SOCKETS**: 3. **VARIABLE COPL VARIOMETER**, including pre-, amplifier coil and other contacts. Complete pieces for coil winding. Plus rack chassis and more. This 22 set (TRANSMITTER RECEIVER) is partly stripped, leaving the maximum of the above good. **THIS IS VALUE FOR MONEY.**
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Estd. 1925

BALCOMBE, SUSSEX



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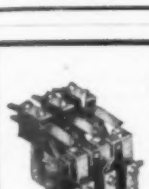

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APPLICATION engineer required by H.F. induction heating equipment manufacturers, London area; duties consist in experimental work to be carried out in connection with customers' enquiries.—Write Box 1455. [4800

APPLICATIONS are invited from qualified television engineers to control central service station in executive capacity; must have good technical and administrative experience; write giving full details to—Box 144... [4455

TELEVISION/RADIO service engineer, fully experienced and able to drive, permanent position with excellent opportunities; full particulars and salary required to—W. J. Elliott, Ltd., Howardsgate, Welwyn Garden City, Herts.

DRAUGHTSMEN required by firm in Middlesex, experience in electrical circuits, telephone and light current apparatus essential.—Write particulars of age, experience and salary required Box 62, W. H. Smith & Son, 265, High St., Uxbridge. [4616

TELEVISION engineer required by sole Murphy dealer, Reading; also H.M.V., Pye, etc., must be to first-class technical standard, and have had pre-war experience of television.—Barnes & Avis, Ltd., 140/141, Friar St., Reading. [4622

ELECTRONIC engineers required for interesting and progressive work in design and development; qualifications: degree or equivalent in electrical engineering or physics, plus actual design experience in one of the following or allied fields:

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DRAUGHTSMEN required by company manufacturing radio communication equipment in S.W. London; experience in diagrams, mechanical design, knowledge of workshop practice an advantage; state age, experience and salary required, to: Box 1427. [4791

ENGINEERS required for servicing radar equipment; technical qualifications: Higher National certificate or degree, previous experience in electronics or radar desirable, commencing remuneration up to £400 per annum, depending on experience or qualifications.

APPLY Construction Department, The British Thomson-Houston Co. Ltd., Rugby. [4652

P.A. engineer required, fully qualified and of smart appearance; experienced in installation and maintenance work; state age, experience and salary required to British Relay Wireless, Ltd., Public Address Department, 111/5, Walworth Rd., London, S.E.17. [4776

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MECHANIC required for the construction and servicing of industrial electronic apparatus, maintenance of mechanical transducers, etc.; West London area; forward full details of education, experience and salary required to—Box A.C.761, c/o Central News, 17, Moorgate, London, E.C.2.

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CHIEF engineer required to take charge of small laboratory at radio manufacturers in N.E. London; must have good technical ability in design of R.F. test equipment and radio components.—Write giving full particulars of qualifications and experience, stating age and salary required, Box 1010. [4627

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WELL-KNOWN electrical manufacturing company requires sales representatives for Birmingham and London areas; applicants, who must be electrical engineers, experienced on outside sales of industrial electronic or similar equipment, should write giving full particulars, quoting Ref. 727, to Box 1454. [4804

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PHYSICIST or engineer, age 25-28, required for interesting development work on gramophone pick ups and other radio components; qualifications: degree or equivalent, plus actual design experience; experience on pick ups would be an advantage; write giving full particulars to—Personnel Department, E.M.I. Engineering Development, Ltd., Sixth Rd., Hayes, Middx. [4839

ENGLISH ELECTRIC require senior and junior instrument draughtsmen for interesting work at Stafford; work covers prototype design and layout of electric meters, instruments and similar devices.—Applicants should write, giving full details of training and experience, quoting Ref. 122, to Central Personnel Services, English Electric Co., Ltd., 24, Gillingham St., Westminster, S.W.1. [4655

MARCONI'S WIRELESS TELEGRAPH Co. require for their research laboratories at Chelmsford, senior and junior research and development engineers for domestic television receivers; applicants, who must have had extensive experience in television receivers, should write giving full particulars, quoting reference 266 to Central Personnel Services, English Electric Co., Ltd., 24-30, Gillingham St., London, S.W.1. [4651

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MARCONI'S WIRELESS TELEGRAPH Co., Chelmsford, require a senior engineer to take charge domestic television receiver research and development; applicants with extensive experience in this class of work and with a capacity to lead a development team should write giving full details of previous experience, quoting Ref.296 to—Central Personnel Services, English Electric Co., Ltd., 24-30, Gillingham St., Westminster, S.W.1. [4826

APPLICATIONS are invited for the position of lecturer in radio engineering at Marconi College, Chelmsford; applicants must be of degree standard either in engineering or physics, and preference will be given to those possessing a good radio background either in a civilian or service capacity; write in confidence giving full details of previous experience, quoting Ref. 266, to Central Personnel Services, English Electric Co., Ltd., 24-30, Gillingham St., Westminster, S.W.1. [4788

AN assistant to the chief development engineer is required by large company manufacturing radio components and allied products; applicants must have technical education to B.Sc. in electrical engineering or physics and must have experience of development work in the radio field; a permanent and progressive position will be offered to an applicant with these qualifications and between the age of 30 and 35 years.—Kindly state fullest details in strict confidence to Box 1498. [4852

VACANCIES exist in the Nelson research laboratories of the English Electric Co., Ltd., Stafford, for senior and junior physicists and engineers for work in the vacuum physics laboratory; a degree in physics or engineering essential, and preference will be given to men experienced in electron optics and vacuum techniques.—Write, giving full details, quoting Ref. 308, to Central Personnel Services, English Electric Co., Ltd., 24, Gillingham Street, Westminster, S.W.1. [4854

THE south-western division of a leading radio company invite applications for the post of chief draughtsman; applicants should have qualification to A.M.I.Mech.E. examination standard or equivalent and have had not less than two years' experience of senior responsibility in a drawing office concerned with layout and detailing of radio equipment, electronic apparatus and small mechanisms; salary will be commensurate with qualifications and experience, and housing accommodation can be made available to successful candidate; entry into pension scheme is offered after a period of service; full details in writing to be made within 7 days of the appearance of this advertisement.—Box 1459. [4820


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TECHNICAL assistant required in patent department of company engaged in the manufacture of precision instruments, radar, etc.; knowledge and experience of electronics and UHF technique required and experience of patent work; salary according to qualifications and experience. Write stating age, experience, etc., to Personnel Manager, Sperry Gyroscope Co., Ltd., Great West Rd., Brentford, Middlesex.

VACANCIES exist at the Nelson Research Laboratories, English Electric Co., Ltd., Stafford, for draughtsmen. Applicants must have had experience of electronic circuit or similar work and preference will be given to those interested in electronic circuit development; salary in accordance with age, qualifications and experience.—Write giving full particulars, quoting reference 109, to Central Personnel Services, English Electric Co., Ltd., 24-30 Gillingham St., Westminster, S.W.1. [4654

ENGLISH ELECTRIC invite applications from University-trained electronic engineers with radar experience covering centimetre aerials, wave guides and receivers; circuit and general electronic experience essential; interesting work near London for which a salary of £850 per annum upwards will be paid for a senior man according to qualifications and experience.—Write, giving full details, quoting Ref. 52, to Central Personnel Services, English Electric Co., Ltd., 24-30, Gillingham St., Westminster, S.W.1.

ENGLISH ELECTRIC invite applications from electrical engineers for appointments in the high voltage section of the Nelson Research Laboratories, Stafford; applicants should have a sound knowledge and experience of H.V. problems and heavy electrical equipment; a degree in electrical engineering is desirable and applicants must be interested in research and development.—Write, giving full particulars, quoting Ref. 229, to Central Personnel Services, English Electric Co., Ltd., 24-30, Gillingham St., Westminster, S.W.1. [4811

ELECTRONICS Engineer.—Applications are invited for the position of Instrument Engineer (Electronics) in a large iron and steel works plant in this country. Candidates will be required to undertake the original design and development of electronic apparatus and its application to works problems. Previous steel-works experience is not essential but initiative and technical ability are considered of first importance. A substantial salary will be paid to the suitable applicant.—Replies giving details of experience to Box 1052. [4705

ENGLISH ELECTRIC require a senior circuit engineer (electronics) for their Nelson Research Laboratories at Stafford. Applicants must hold a university degree or Associate Membership of the Institution of Electrical Engineers, have had two or three years' industrial experience, and be interested in the development of electronic circuits. The work will involve design of special circuits.—Write, giving full particulars, quoting reference 518, to Central Personnel Services, English Electric Co., Ltd., 24-30, Gillingham St., Westminster, S.W.1. [4650

ENGLISH ELECTRIC invite applications from electrical engineers for appointments at their Nelson Research Laboratories, Stafford; applicants should have a sound knowledge of heavy electrical engineering, and experience in the operation and maintenance of heavy electrical plant; a degree in electrical engineering is essential, and an interest in development desirable; successful candidates will be required for special duties in connection with short circuit testing.—Applicants should write, giving full information, quoting Ref. 229, to Central Personnel Services, English Electric Co., Ltd., 24-30, Gillingham St., Westminster, S.W.1. [4810

CINEMA-TELEVISION, Ltd.—Applications are invited from television development engineers for positions in a new section now being formed; applicants should have several years' television circuit development experience in one or more of the following fields: (a) timebase and scanning equipment, (b) vision and sound receivers, (c) high and low voltage power units, and preferably have commercial experience in designing equipment for production.—Apply in writing, giving age, qualifications, details of experience, salary required, etc., to the Personnel Department, Cinema-Television, Ltd., Worsley Bridge Rd., Lower Sydenham, S.E.26. [4846

APPLICATIONS are invited for the position of assistant to senior mechanical engineer which exists within the organisation of a light engineering company; applicants must have technical qualifications equivalent to a good Degree in Engineering; experience must cover all phases of production engineering, including mechanical design of radio-communication and electronic equipment, design of pressed tools and planning and estimating; the salary which will be paid to the successful applicant will be up to £750 per annum, and the age range is from 35-45 years.—Applications, giving full details of qualifications, experience and salary required, should be addressed to Box 1426. [4799

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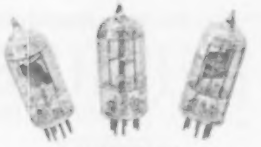

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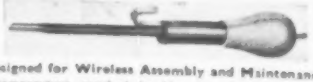

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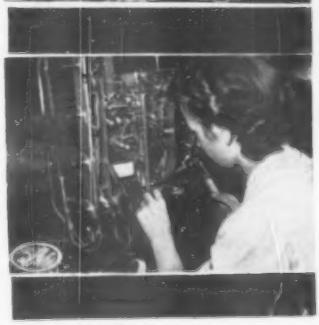

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